DRAFT

Initial Environmental Examination

June 2014

PAK: Trimmu and Panjnad Barrages Improvement Project

(Rehabilitation & Upgrading of Panjnad Barrage)

Prepared by NESPAK-ABB-DMC joint venture consultant for PIAIP for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 3rd March 2014)

Currency unit – Pakistan Rupee (Rs)

$1.00 = Rs. 97.97 (International Forex Rate)

NOTE

In this report, "$" refers to US dollars. Unless otherwise stated.

IRRIGATION DEPARTMENT

GOVERNMENT OF THE PUNJAB

DRAFT INITIAL ENVIRONMENTAL EXAMINATION (IEE)

for

REHABILITATION AND UPGRADING OF PANJNAD BARRAGE

October 2013

NESPAK-AAB- DMC JOINT VENTURE CONSULTANTS FOR PIAIP

National Engineering Services Pakistan (Pvt.) Limited

AAB (Pvt.) Limited

Development and Management Consultants

REHABILITATION AND UPGRADING OF PANJNAD BARRAGE

INITIAL ENVIRONMENTAL EXAMINATION

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List of Abbreviations

ADB	Asian Development Bank
AIDS	Acquired Immunodeficiency Syndrome
AC	After Construction
AFFF	Aqueous Film Forming Foams
Amsl	Above Mean Sea Level
AOI	Area of Influence
BOD_5	Biochemical Oxygen Demand
BC	Before Construction
BDL	Below Detection Limit
BHU	Basic Health Unit
BOQ	Bill of Quantities
CCA	Cultivable Command Area
COD	Chemical Oxygen Demand
CO_2	Carbon Dioxide
CH_4	Methane
CSC	Construction Supervision Consultants
CFCs	Chlorofloro Carbons
CO	Carbon Monoxide
COSHH	Control of Substances Hazardous to Health
CSCEnv	Construction Supervision Consultants Environmentalist
CMS	Change Management Statement
CEnv	Contractor's Environmentalist
Cft	Cubic feet
Cfu	Colony Forming Unit
CDM	Clean Development Mechanism
DC	During Construction
DO	Dissolved Oxygen
D/s	Downstream
DMC	Development and Management Consultants
DPs	Displaced Persons
DFs	Displaced Families
DD	Deputy Director
dB	Decibel
DPC	Displaced Persons Committee

EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMMP	Environmental Management & Monitoring Plan
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EPAs	Environmental Protection Agencies
ESU	Environment and Social Unit
ERP	Emergency Response Plan
EA	Environmental Assessment
FAO	Food and Agriculture Organization
FPSP	Flood Protection Sector Project
Ft	Feet
GCA	Gross Cultivated Area
GHGs	Greenhouse Gases
GoP	Government of Punjab
GDP	Gross Domestic Product
GEL	Global Environment Lab
GIS	Geographical Information System
GRR	Grievance Redress Register
GRC	Grievance Redress Committee
Ha	Hectare
HTV	Heavy Transport Vehicle
HFL	High Flood Level
HIV	Human Immunodeficiency Virus
HSE	Health, Safety & Environment
Kg	Kilogram
Km	Kilometres
LMB	Left Marginal Bund
LRE	Left Retaining Embankment
LARP	Land Acquisition and Resettlement Plan
LAA	Land Acquisition Act
LAC	Land Acquisition Collector
LTV	Light Transport Vehicle
LARF	Land Acquisition and Resettlement Framework
IEE	Initial Environmental Examination
IPCC	Intergovernmental Panel on Climate Change

IWT	Indus Water Treaty
ISO	International Organization for Standardization
M&E	Monitoring and Evaluation
Mm	Millimeters
mg/l	Milligrams per liter
meq/l	Milliequivalents per liter
MPN	Most Probable Number
NCS	National Conservation Strategy
NEQS	National Environmental Quality Standards
NESPAK	National Engineering Services Pakistan
NO_x	Oxides of Nitrogen
NOC	No-Objection Certificate
NDC	National Development Consultants
NGOs	Non-government Organizations
NTU	Nephelometric Turbidity Unit
N_2O	Nitrous Oxide
O&M	Operation and Maintenance
P&D	Planning and Development Department
PM	Particulate Matter
Ppm	Parts per million
PEPA	Pakistan Environmental Protection Act
PEPC	Pakistan Environmental Protections Council
PMO	Project Management Office
PPC	Pakistan Penal Code
PIU	Project Implementation Unit
PPE	Personal Protective Equipment
PMD	Pakistan Metrological Department
PIAIP	Punjab Irrigated Agriculture Investment Program
PIDA	Punjab Irrigation and Drainage Authority
PID	Punjab Irrigation Department
PVC	Polyvinyl Chloride
PHS	Public Health and Safety
RSC	Residual Sodium Carbonate
R & U	Rehabilitation and Upgrading
RD	Reduced Distance
RL	Reduced Level

RE	Resident Engineer
RMB	Right Marginal Bund
RoW	Right of Way
REA	Rapid Environmental Assessment
RGB	Right Guide Bank
RAP	Resettlement Action Plan
RP	Resettlement Plan
RRE	Right Retaining Embankment
SAR	Sodium Absorption Ratio
SA	Social Assessment
SO_x	Oxides of Sulphur
SAP	Social Action Plan
SCARP	Salinity Control and Reclamation Project
SSEMP	Site Specific Environmental Management Plan
SEMU	Social & Environmental Management Unit
SFA	Social Framework Agreement
SMO	SCARPS Monitoring Organization
SOP	Standard Operating Procedure
SVP	Sutlej Valley Project
SSOP	Soil Survey of Pakistan
S/S	Solidification/Stabilization
TDS	Total Dissolved Solids
TON	Threshold Odor Number
TSS	Total Suspended Solids
TBT	Tool Box Talk
US-EPA	United States Environmental Protection Agency
µS/cm	MicroSiemens per centimeter
U/s	Upstream
$\mu g/m^3$	Microgram per cubic meter
UNO	United Nation Organization
WAPDA	Water and Power Development Authority
WWF	Worldwide Fund for Nature
XEN	Executive Engineer

UNITS AND CONVERSION FACTORS

Length

1 inch	=	25.4 millimeters				
1 meter	=	3.281 ft				
1 mile	=	1609 meters	=	1760 yards	=	5280 ft

Area

1 sq. m	=	10.76 sq. ft	=	1.196 sq. yd	
1 hectares	=	2.47 acres	=	10,000 sq. m	
1 sq. km	=	100 hectares			

Volume

1 US wet gallon	=	0.833 imperial gallon	=	3.785 liters
1 US dry gallon	=	0.967 imperial gallon	=	4.404 liters
1 cu. meters	=	35.31 cu. ft		

EXECUTIVE SUMMARY

S-1 Introduction

1. Government of Punjab is planning to undertake the rehabilitation of Punjab Barrages and improvement and modernization of the irrigation and water management system in the Punjab Province which include the rehabilitation and up-grading of the Panjnad Barrage. ADB is providing fund for Panjnad Barrage Rehabilitation & Up-grading work. The Environmental Assessment study of the proposed project has been carried out in accordance with Pakistan statutory requirement and Asian Development Bank Environment Policy.

2. Panjnad Barrage is situated just below the confluence of River Sutlej and Chenab and was constructed during 1925 – 1929 under the Sutlej Valley Project (SVP). The barrage was re-commissioned in 1932 for design discharge of 700,000 cusecs. The Barrage pond area falls in Tehsil Alipur (District Muzaffargarh) and Tehsil Ahmedpur East (District Bahawalpur). It is linked with the rest of the country through an inter-district road. The road bridge at Panjnand Barrage is utilized by the heavy traffic from Karachi to Bahawalpur to Multan etc. The alternative upstream river crossing on Chenab River is located on Multan - Muzaffargarh road (N70) and at Bahawalpur – Lodharn road (N5) on Sutluj River. The nearest downstream river crossing is located at Guddu Barrage on Indus River. Three canals viz. Panjnad, Abbasia and Abbasia Link Canals are fed from this barrage. The Barrage commands a gross area (GCA) of 1.81 million acres and provides irrigation supplies to cultivated command area (CCA) of 1.62 million acres (0.66 million ha) falling mainly 96% in district Rahim Yar Khan.

3. The barrage is about 80 years old now and aging process together with inadequate discharging capacity has also contributed towards general deterioration of the different components of the Barrage. Punjab Irrigation Department (PID) engaged National Development Consultants (NDC) in June 1998 for the safety evaluation of Panjnad Barrage. The study recommended that rehabilitation and upgrading of the barrage be undertaken to ensure safe operation of the barrage. Based on these recommendations, a Feasibility Study for Rehabilitation & Upgrading of the barrage was conducted and prepared in February 2012.

4. In 2009 with the funding from Asian Development Bank (ADB), the PID initiated “Punjab Irrigated Agriculture Investment Program (PIAIP)”. The consultancy for detailed design of the project was assigned to a joint venture of NESPAK, AAB and DMC. One of the components of PIAIP is Feasibility Study and detailed design for the Rehabilitation and Upgrading of Panjnad Barrage.

S-2 Legal and Administration Framework Policy

5. Pakistan Environmental Protection Act 1997 is a primary legislation applies in environmental assessment studies in Pakistan. Under section 12 (with subsequent amendment) of the 1997 Act, a project falling under any category specified in Schedule I (SRO 339(1)/2000), requires the proponent to file an IEE with concerned federal agency (Pak-EPA). Projects falling under any category specified in schedule II require the proponent to file an EIA with the federal agency. The estimated total cost of this project is well above from 50 million Pak Rupees, therefore, a separate EIA report is prepared for EPA Punjab.

6. All project activities should be in compliance with NEQS and should establish monitoring and evaluation systems, as required under Pak-EPA.

7. Under ADB Environment Policy, projects are to be categorized in to the three environmental categories; A, B and C according to significance of the adverse environmental impacts. This Project have some adverse environmental impacts, but of lesser degree and significance. Panjnad Barrage is not a new mega project. It is rehabilitation and upgrading of the existing structure to enhance the barrage capacity. The anticipated adverse environmental impacts of the project shall be local, limited and mitigable. All such projects according to ADB Safeguard Policy Statement 2009 require having an IEE.

S-3 Project Details and Alternatives

8. The studies of structural and mechanical components of the Barrage have envisaged some structural and hydraulic problem together with mechanical defects. These defects, if not rectified the consequences could be devastating with the consequent risk of the failure of the whole system. Such a failure would adversely affect the economy of the farming community in the command area.

9. The scope of work will include repair of the barrage structure including barrage floor, arrangements for safe passage of 100 years flow, replacement of road bridge deck of the barrage, repair/replacement of regulation gates, gearing and hoisting devices, modernization of barrage structure, installation of new vibrating wire piezometers and trimming of the shoals (bela) in the pond area.

10. In order to improve the barrage resistance against the uncontrolled breaches, the embankments will be strengthened. The “bela” upstream of the pond area will be partially trimmed to improve the approach conditions of the river. Upstream and downstream floor of the barrage will be inspected and necessary repair works will be carried out. In addition, the substrata and voids underneath the floors will be grouted under pressure. It is also concluded from statistical analysis of the river discharge record that the barrage capacity is around 165,000 cusecs less than the 100 year return period flood. Three options have been considered to increase the barrage discharge capacity;

Option 1: Adding 11 bays on the right side without raising High Flood Level (HFL)
Option 2: Provision of gated bypass weir structure, spill channels and bridge over gated structure for Bahawalpur – Uch - Alipur- Muzaffargarh road
Option 3: Provision of 4 Nos. of Additional Depressed Bays utilizing the existing Junction Groyne with raised HFL.

11. Noticeable environmental and social adverse impacts are associated with option 1 and 2 while no significant or permanent adverse environmental or social impacts are anticipated for option 3. Therefore option 1 & 2 rejected on the basis of higher adverse environmental and social impacts. Option 3 has been recommended for detail design. It is anticipated that the project construction will be completed in three years in such a way that the river flows will not be interrupted in the construction phase. Gates of canal’s head regulators will be repaired during annual canal closure period. Therefore no extended canal closures will be required.

S-4 Environmental Baseline Condition

12. Baseline Conditions of the project area have been established through the data collected from the field and direct interaction with the local community and officials from the various departments. Previous studies (secondary data) have also used in the development of the baseline. The baseline information covers the prevailing physical, biological and social

environment of the area. The information utilized for the IEE was obtained by using GIS technology, stakeholder consultation including Wildlife, Fishery & Forest Department, and NGOs etc. Field visits were carried out by the environment team and laboratory based testing of the physical parameters (water, ambient air and noise) was undertaken by GEL. The results are provided in Chapter 4. The objective of the stakeholder consultation was also to explain the project intervention and their potential impacts on the environment of the area and also share the mitigation measures with the local community to promote a general good will towards the project in the community.

13. Surface water testing at the barrage indicates that the river water does meet the NEQS level and FAO standards for agriculture purposes and fit for irrigation and recreational activities. Groundwater samples were collected and tested from the existing tubewell at the barrage and found unsatisfactory for drinking due to elevated Lead, Turbidity, Total Coliform, Cadmium and Boron levels.[1]

14. It was found from ambient air quality monitoring that air is reasonably clean at present as all the monitored parameters are within the limits of NEQS level. The climate of the area is arid characterized by long hot summer and shorter winter. Wind speed varies significantly over the year. Peak values were recorded during June and September during year 2010. The typical wind direction is south to north in most of the part of the year.

15. The barrage pond area provides the habitat of many species of migrating waterfowl and game birds. Partridge is the local specie of game bird reported in the barrage pond area. Fish ladder is provided along divide wall at left side of the Barrage. The functioning of the fish ladder is reported satisfactory.

16. The Socio Economic Survey was conducted with the objectives to assess prevailing socio-economic conditions of the related communities and to predict the effects of the proposed different alternatives of rehabilitation works. Simple Random Sampling Technique was used to draw representative sample. The average household size is 7.0 and the sex ratio (female: male) is 110:100. There are 5 Primary and 2 Middle Schools for boys, 5 Primary and 1 Middle School for girls found in the area. The literacy ratio in Ali Pur Tehsil, Ahmedpur East Tehsil, Muzaffargarh district and Bahawalpur district is about 23 %, 24 %, 28 % and 35 % respectively. In Punjab Province the ratio is 47%. It was found that about 67% of the affected head households of the urban area are engaged in labor and 33% of the affected head households of the rural area are engaged in agriculture. 99% of the respondent are Muslim and speak Siraiki language. The major castes of the area are Lashari, Mevery, Chandiay, Sial, Gopang, Qasirni and Mahana. Wheat and Cotton are the major crops cultivated in the area. Female participation for the betterment of the family is more as compared to males. In fact, rural women of the area work 11 hours per day. About 61% and 71% women participate in agriculture and livestock activities respectively.

S-5 Potential Impacts, Mitigation Measures and EMP

17. The carried out Initial Environmental Examination revealed that the project activities will not cause any significant disturbance and inconvenience to local community and natural environment of the area. Construction related impacts such as air pollution; noise etc. will be mitigated by the implementation of the EMP. All the solid waste and wastewater generated from

[1] Groundwater is not suitable for drinking.

the project activities and labor camp should be disposed of according to the waste disposal plan, which is a component of the EMP. The chances of land contamination from effluents, accidental spills and leaks should be avoided and Material Safety Data Sheets (MSDS) will be placed in fuel storage area. The construction activities might require the closure of Road Bridge and traffic will be managed according to Traffic Management Plan furnished by the contractor in the lines of illustrated plan provided in Section 7.9. The available PID land in the close vicinity of the Project site would be utilized for Contractor's camp facilities. Groundwater is the major source of drinking water for the local community. It is very important to protect the water sources during the construction phase from accidental spills of diesel or any chemical, as any spill could percolate to the groundwater through the sandy stratum at site. It is concluded from the test results that if the groundwater is to be used for the water supply in the Labor Camp then it is the responsibility of the Contractor to extract water from sufficient depth or provide filtration plant and confirm that it meets the NEQ standards.

18. During construction, the Contactor's work force is expected to be largely available from the local population, which will enhance the economic opportunities for the locals of working age group. New plantation will be undertaken to enhance the biodiversity of the project area. It will also raise the aesthetic value of the area and attract more visitors.

19. Socioeconomic conditions of the project area will generally be positively impacted due to the project implementation. There are few temporary negative impacts associated with the construction phase e.g. extra burden on the local welfare facilities i.e. water supply, electricity, transportation services etc. However, these impacts are insignificant and mitigable. The anticipated impacts of the project have been addressed and the mitigations proposed in the section covering EMP for the execution of the project activities in an environment friendly manner. The estimated cost of implementation of the EMP is PKR 16.716 million.

S-6 Conclusion

20. The project will have net positive impact on the environment of the area. The barrage discharge capacity will be increased and therefore the risk of damaging crop, infrastructure, livestock etc due to uncontrolled breaching in case of flood will be minimized. Availability of jobs during construction phase shall employ and train number of unemployed local youth. Potential adverse environmental & social impacts of the project are associated with mainly the construction phase of the project and all of these impacts are temporary, localized and reversible in nature. These impacts can be mitigated through the proper implementation of the EMP. Therefore it is concluded that this project is environmentally friendly, financially viable, economically sustainable, generally neutral and pro-poverty alleviation.

1. INTRODUCTION

1.1 GENERAL

1. Punjab Province is the agricultural backbone of the country. The contribution of Punjab agriculture sector is 28% to the GDP (Government of the Punjab, Punjab Economic Report, 2007). The irrigation system of the Punjab is a part of vast Indus River Basin and draws its supplies through 14 Barrages/Headworks constructed on the main Indus River and its major tributaries; Jhelum, Chenab, Ravi and Sutlej rivers. There are 24 canal systems off taking from these 14 barrages with a total withdrawal capacity of 110,900 cusecs.

2. Panjnad Barrage is situated just below the confluence of River Sutlej and Chenab rivers in the South-Eastern part of Muzaffargarh district. The barrage was constructed during 1925 - 1929 with a designed discharge capacity of 450,000 cusec for a discharge intensity of 227.0 cusec/ft. In September 1929, flood of 550,000 cusec was received at the barrage site and the Islam enquiry committee recommended raising its design discharge capacity to 700,000 cusec. The discharge intensity was upgraded as 248 cusec/ft. The barrage was re-commissioned in the year 1932. After passing through Panjnad Barrage, the river ultimately joins Indus River at Sarki village near Mithan Kot, downstream of Taunsa barrage and upstream of Guddu barrage. Three canals i.e. Panjnad Canal, Abbasia Canal and Abbasia Link Canal with design discharge of 7,769 cusecs, 1,064 cusecs and 5,600 cusecs respectively, off take from left side of the barrage.

3. Panjnad Barrage gross command area (GCA) is 1.81 million acres and provides irrigation supplies to cultivated command area (CCA) of 1.62 million acres (0.66 million ha) falling mainly 96% in district Rahim Yar Khan through Panjnad, Abbasia and Abbasia Link canal systems. The Barrage is located in Tehsil Alipur (District Muzaffargarh) and Tehsil Ahmedpur East (District Bahawalpur). It is linked with the rest of the country through an inter-district road. The upstream bridge located on Chenab River is on Multan Muzaffargarh road and at Bahawalpur – Lodhran road on Sutluj River. The nearest downstream river crossing is available at Guddu Barrage on Indus River.

1.2 BACKGROUND

4. Panjnad Barrage is the last barrage on River Chenab situated at downstream confluence point of River Sutlej in the South-Eastern part of Muzaffargarh district. It was constructed during 1925 -1929 with the design discharge of 450,000 cusec to irrigate 1.8325 million acres of Bahawalpur and Rahimyar Khan Districts by diverting 11,882 cusecs of water. In September 1929, floods of 550,000 cusec were received at barrage site and the Enquiry Committee recognized the inadequacy of the designed discharge capacity of Barrage and recommended the widening of water-way for design discharge of 700,000 cusecs. The barrage was re-commissioned in the year 1932.

5. The system functioned quite well till independence when supplies of three eastern rivers; Ravi, Sutlej and Beas were cut off by India and the issue was resolved with the help of the World Bank through the “Indus Waters Treaty” of 1960 where water rights of Eastern rivers; Ravi, Beas and Sutlej were given to India while of Western rivers; Chenab, Jhelum and Indus given to Pakistan. Subsequently, a system of 8 link canals was constructed to transfer the water of the Western Rivers to the areas of the Eastern Rivers in Pakistan. This disturbed the operation of the barrages as well as the hydraulic and sedimentation characteristics of the

canals off-taking from all the rivers in the Province, as the entire available supplies in the rivers had to be diverted into the canal network to sustain agriculture. Panjnad canal and Abbasia canal off take from left side of barrage. In 2004-2005, Abbasia Link canal head regulator was constructed annexed to existing head regulators. Manually operated Gate Equipment has been installed on Main Barrage and Head Regulators of three (3) off-taking canals.

6. Panjnad Barrage has exhausted 80 years of its life and suffers from aging and inadequate discharging capacity, thus jeopardizing, threatening their safety and needs to be rehabilitated. The rehabilitation and upgrading works will be carried out under the Punjab Irrigated Agriculture Investment Program (PIAIP). Punjab Irrigation Department (PID) is the executing agency of the Punjab Irrigated Agriculture Investment Program (PIAIP). The consultancy of the project including feasibility and detailed design work was awarded to a joint venture of NESPAK, AAB and DMC.

7. Historic discharge data of Panjnad Barrage from 1950-2010 indicates that the flood discharge at Barrage exceeded the designed capacity of the barrage three times; in 1973 (802,516 cusecs), 1976 (710,102 cusecs) and 1992 (812,000 cusecs). During Super floods of 1973 and 1992 breaches took place in left and right marginal bunds.

1.3 PURPOSE OF THE REPORT

8. The purpose of this report is to present the findings of the Initial Environmental Examination studies, including identification of the environmental baseline i.e. physical, biological and socio-economic/cultural conditions and assess all possible impacts arising during the proposed project activity on the environment along with proposing suitable mitigation measures and formulation of environment management plan (EMP) to ensure the project commencement and implementation in an environmental friendly manner. Adequate mitigation measures and corresponding implementation mechanisms have been proposed so that these could be incorporated duly during the proposed project activity with due consideration. The report provides relevant information, as required under the ADB Safeguard Policy Statement 2009 and EPA's officially approved format, to help the decision makers in issuing the Environmental Approval.

1.4 PROJECT OBJECTIVE

9. The project aims to upgrade water resources and irrigation infrastructure of Panjnad Barrage and to propose remedial measures for the following main problems:

(i) The barrage capacity is about 165,000 cusecs less than the calculated 100 years return flood. Increase the barrage capacity or provide the alternative arrangement e.g. bypass gated weir or adding more gate at the end of the barrage or using existing junction groyne to handle the 100 years flood at the barrage.
(ii) High floods caused heavy damages through breaches in the marginal bunds because the barrage capacity is less than the 100 years return flood discharge. There is a need for the enhancement of barrage capacity.
(iii) Restore the existing Barrage to perform its designed functions and ensure improved and reliable irrigation supplies.
(iv) The approach of the river to the barrage is oblique, which partially incapacitates the weir function and makes/renders the marginal bunds unsafe in high floods.
(v) Bela formation in the barrage pond area is reducing the barrage capacity.

(vi) The decking of the road bridge has been deteriorated and become risky for present traffic requirements.
(vii) Need for the enhancement of barrage capacity for severe floods.

10. These objectives would be achieved through effective flood management of 100 years return period floods, by rehabilitation and up-grading Panjnad barrage besides provision of additional allied structures, structurally strengthening the existing barrage, modernizing the electro-mechanical components of the barrage; and improving operation, maintenance and emergency preparatory arrangements.

1.5 NEED OF THE PROJECT

11. Most of the 14 barrages in Punjab are now more than 80 years old and are in acute distress owing to aging, design deficiencies, constructional defects, hydraulic and mechanical problems, inadequate operation and maintenance, and drastic changes in river morphology as a result of the implementation of the IWT. Serious damage to any of these barrages resulting in an interruption of irrigation supplies can have disastrous implications on the country's economy and the population of the area. The rehabilitation and upgrading of these barrages has therefore been considered by the Government as an urgent necessity.

12. Panjnad Barrage is now 80 years old and in the aging process along with inadequate or deferred maintenance has resulted in general deterioration and damages of its different components like the gates and gearing. The cracks have appeared on floor and piers, the barrage floor has grouting cavities and shotcreting, the divide wall is damaged, and the bela formation reduced the pond capacity. The floods of 1973 and 1992 caused the breaches in left and right marginal bunds and the flood discharge exceeded the barrage design capacity. The distorted flow pattern oblique entry of the river to the barrage partially incapacitates the weir function and any further damage to this barrage can result in colossal losses in the form of total or partial disruption of irrigation supplies, agricultural crops, loss of government revenue, and rehabilitation cost of emergency repairs. The barrage has therefore required rehabilitation and repairs. The Punjab Government has given due attention to Panjnad Barrage and has included it in the program of rehabilitation of barrages in Punjab.

1.6 PROJECT LOCATION

13. The barrage is located at latitude of 29° - 21' North and longitude 71° - 02' East. The barrage falls in Tehsil Alipur (District Muzaffargarh) and Tehsil Ahmedpur East (District Bahawalpur). The barrage location is indicated on Figure-1.1. Panjnad Barrage is linked with the rest of the country with an inter-district road. An important National Highway "Multan-Muzaffargarh-Panjnad-Karachi" passes over this barrage. The site is accessible by road from Lahore through alternate routes:

(i) Lahore – Khanewal – Lodhran – Bahawalpur – Uch Sharif – Panjnad
(ii) Lahore – Multan – Muzaffargarh – Alipur - Panjnad

14. Uch and Alipur are 14.2 km and 12.7 km away respectively from the barrage. The upstream bridge located on Chenab River is on Multan Muzaffargarh road and downstream on Indus River at Guddu Barrage on Deherki-Kashmore road (200 km). In winter, a boat bridge is also installed about 90 km downstream of the barrage on river Indus below the confluence point of rivers, joining Chachran and Kot Mithan towns of district Rahimyar Khan and Rajanpur.

1.7 PROJECT DESCRIPTION

15. This Project envisages feasibility and detailed design of rehabilitation and upgrading works of Panjnad Barrage. In feasibility study, provides details on the existing infrastructure and discusses the following three options and option 3 was recommended for detail design.

Option 1: Increasing Barrage Capacity by Addition of Bays

16. This option requires addition of eleven (11) new bays (60 ft wide gates and related equipment) at HFL 341.55 ft. under average tail-water condition. The upstream water level for this option is considered as 342.04 ft. These gates will be installed to the right side of the new dividing groyne on the right side of existing annexe weir. Crest elevation of all the new gate equipment shall be the same as that of the main weir and annexe weir i.e. 325.0 ft.

Option 2: Proposed Bypass Gated Weir at Right Marginal Bund

17. There is no canal system on the right side and it would be convenient to provide a bypass gated weir for managing additional discharge. This option comprises provision of a 730 ft. long reinforced concrete gated weir in the right corridor of RGB from RD 0+800 to RD 1+700 to pass 165,000 cusec surplus discharge. 11 No. bays of 60 ft. separated by 7 ft thick piers have been proposed with crest level at RL 325.00.

Option 3: Provision of 4 Nos. of Additional Depressed Bays utilizing the existing Junction Groyne

18. This option requires construction of 4 additional depressed bays using the available land of existing junction groyne with increased HFL. River training embankments will be re-modeled according to the raised HFL.

19. A detailed description of the project is included in chapter 3.

1.8 PROJECT AREA OF INFLUENCE

20. Panjnad barrage is located in Tehsil Ali Pur, District Muzaffargarh. The barrage is surrounded mainly by agricultural land. The area of project influence referred to as the “Area of Influence” (AOI) is the area likely to be affected by the project activities. Although the major construction activities remain limited at the barrage, the situations in which construction related activities would extend beyond the construction site include:

- The labour camp site, batching plant, material stock areas, waste dumping site, equipment and machinery yards
- Borrow area for soil materials
- Construction of haul tracks in order to transport construction material

21. The major features of the area and proposed locations of the contractor’s facilities are indicated on the overall environmental study area map and Panjnad Barrage environment map are shown in Figure-1.2 and 1.3 respectively. These maps are prepared using GIS technology and satellite imagery.

1.9 REVIEW OF PREVIOUS STUDIES

22. A Pre-feasibility Study for management of Severe Floods at Panjnad Headworks was carried out by a Joint Venture of NESPAK, Harza Engineering Company, Delft Hydraulics and

Zafar & Associates in 1997 under Flood Protection Sector Project- Phase-1 (FPSP-1). Different alternatives for management of severe floods by making suitable arrangements for passing excessive discharge over design capacity of the barrage 150,000 cusecs (850,000 – 700,000) were framed. The Punjab Irrigation Department (PID) engaged National Development Consultants (NDC) in June 1998 for a safety evaluation of Panjnad Barrage. This study concludes the barrage structure need rehabilitation on urgent basis. PID awarded the work of carrying out Feasibility Study for Rehabilitation & Upgrading of the Panjnad Barrage to the joint venture (JV) of NESPAK in association with AAB and DMC. The Consultants submitted the Feasibility Study Report in February 2012. The study made recommendations to rehabilitate the gates and gearing of barrage, Grouting cavities beneath the barrage floor and Shotcreeting of the floors, raising and strengthening of Guide banks and marginal bunds and remove the bela masking in pond area. The study also conclude that the barrage capacity is approximately 165,000 cusecs less than the 100 years return flood and discharge capacity can be increased by constructing 4 new depressed bays at the available space as junction groyne.

1.10 APPROACH ADOPTED FOR THE ENVIRONMENTAL STUDY

23. The environmental and social data were collected and analyzed for the overall environmental study area. Primary data, including sampling and testing of the physical environmental parameters were collected during site visits conducted from January 2011 to September 2013. Physical environmental parameters were sampled and tested by an authenticated laboratory. The test results are included and analyzed in this report. Secondary data for the overall study area was reclaimed from other institutions e.g. Forestry, Wildlife and Fisheries Department, Punjab Irrigation Department, SCARPS Monitoring Organization, SEMU, Metrological Department and Directorate Land Reclamation (DLR) etc.

24. The base line data was developed and analyzed to identify potential environmental impacts of the Project. A risk based methodology was adopted to identify the high risk activities and suggest their mitigation measures. Where possible, eliminating the risk by altering the scope or method of execution of work was preferred rather than minimizing the risk with control measures. Public consultations were also undertaken inclusive of gender study, to take into account the public point of view about the project.

25. The Social Assessment (SA) has been conducted to evaluate the project's potential positive and adverse effects on the affected people and to examine project alternatives where adverse effects may be significant. The Socio- Economic Survey was conducted by an experienced and qualified team of sociologists. Public consultations were also undertaken inclusive of gender study, to take into account the public point of view about the project.

1.11 EXTENT OF THE STUDY

26. The Initial Environmental Examination (IEE) study of the project takes into account the environmental (physical, biological and chemical) impacts on human health and safety, surrounding communities and under water species. This study evaluates the project's potential environmental risks and impacts on its area of influence, planning, designing and implementation to preventing, minimizing, mitigating or compensating for adverse environmental impacts and enhancing positive impacts throughout project implementation.

27. The breadth, depth and type of analysis in the social assessment are proportional to the nature of the project and scale of its potential effects, positive or adverse, on the affected people.

1.12 STRUCTURE OF THE REPORT

28. This report is divided into following chapters.

Chapter 1 Introduction
Chapter 2 Legal and Administrative Framework Policy
Chapter 3 Project Description
Chapter 4 Baseline Conditions
Chapter 5 Analysis of Alternatives
Chapter 6 Impact Assessment, Mitigation and Enhancement Measures
Chapter 7 Environmental Management Plan
Chapter 8 Public Consultation

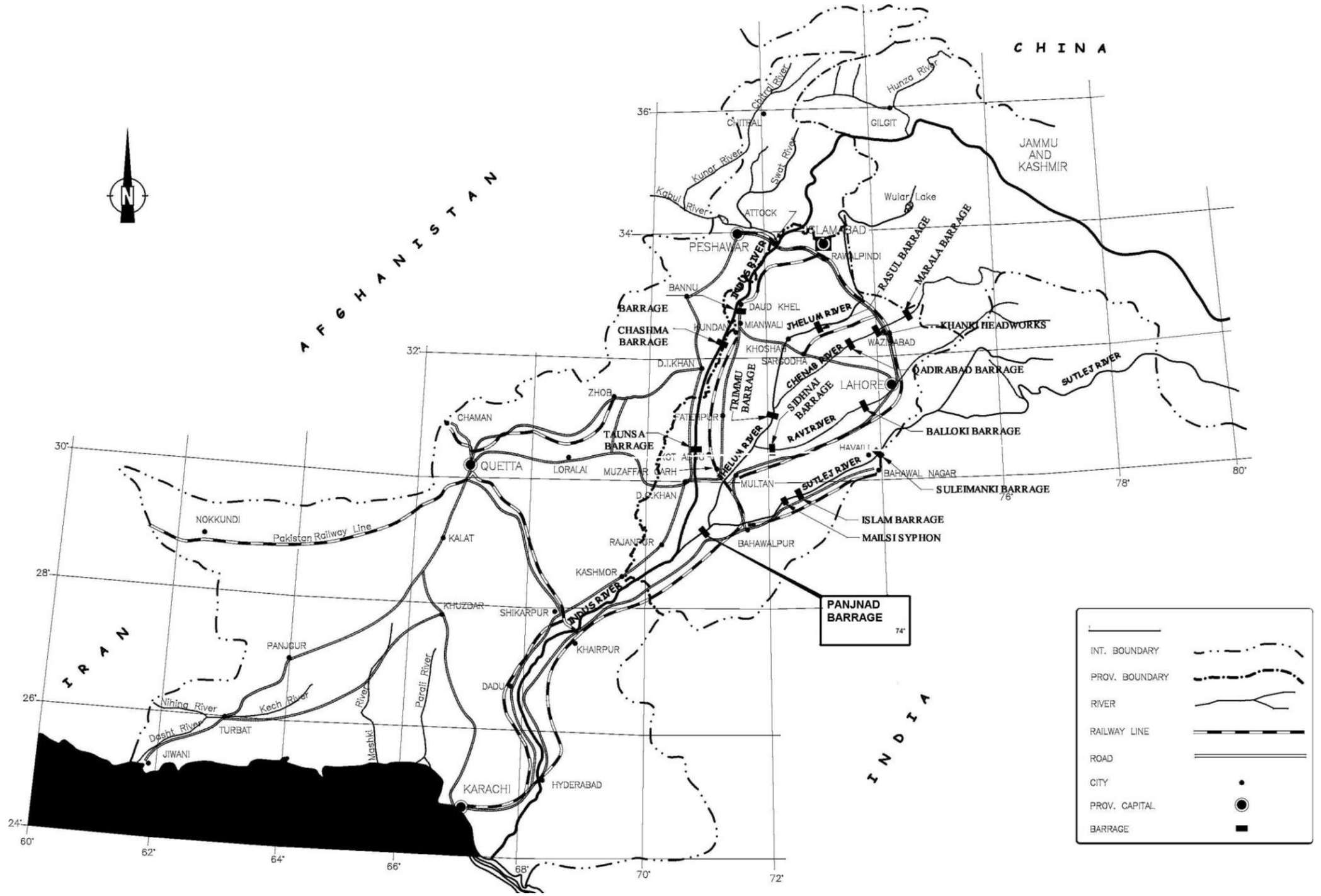

Figure 1-1 Project Location Map

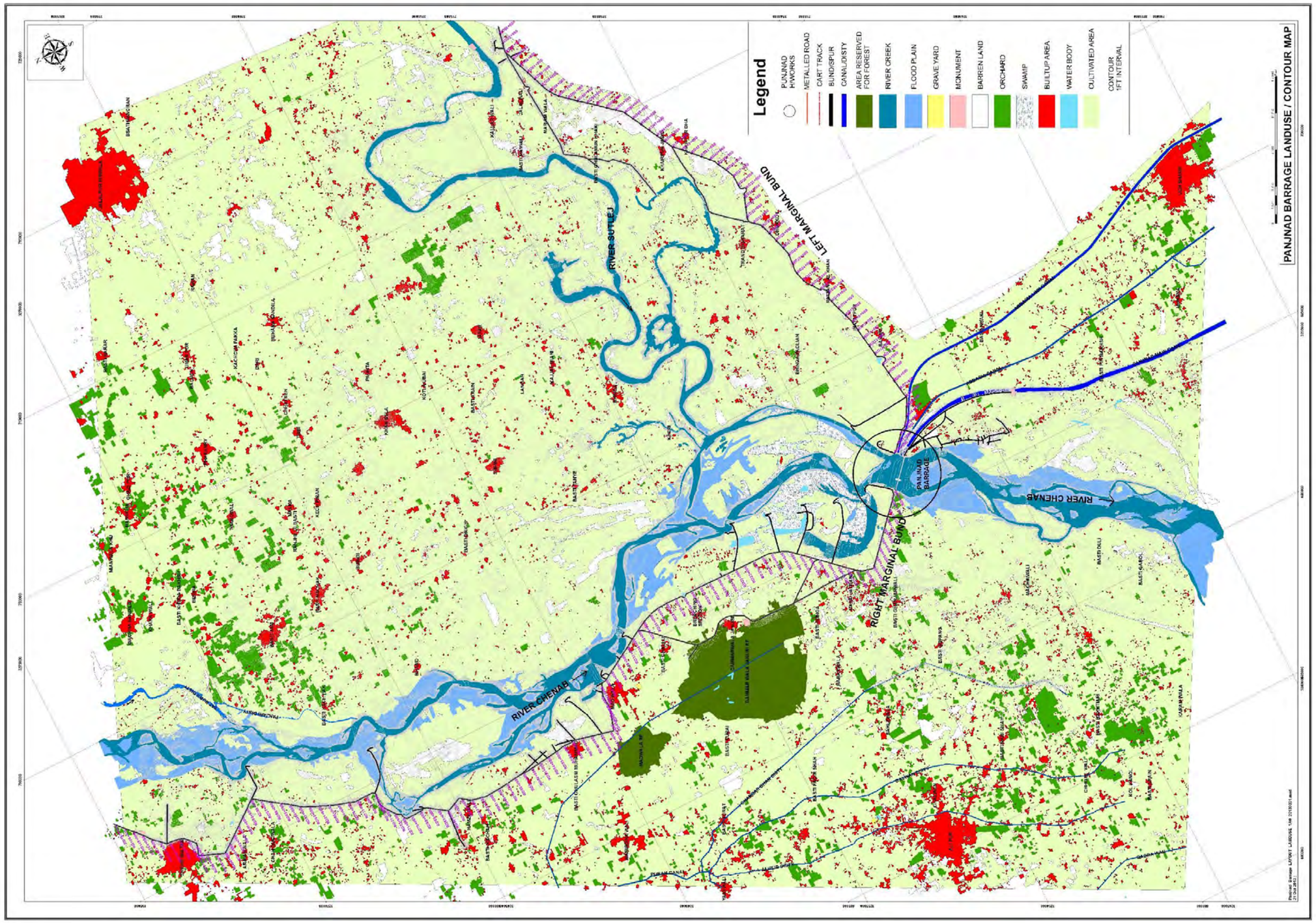

Figure 1-2 Overall Environmental Study Area Map

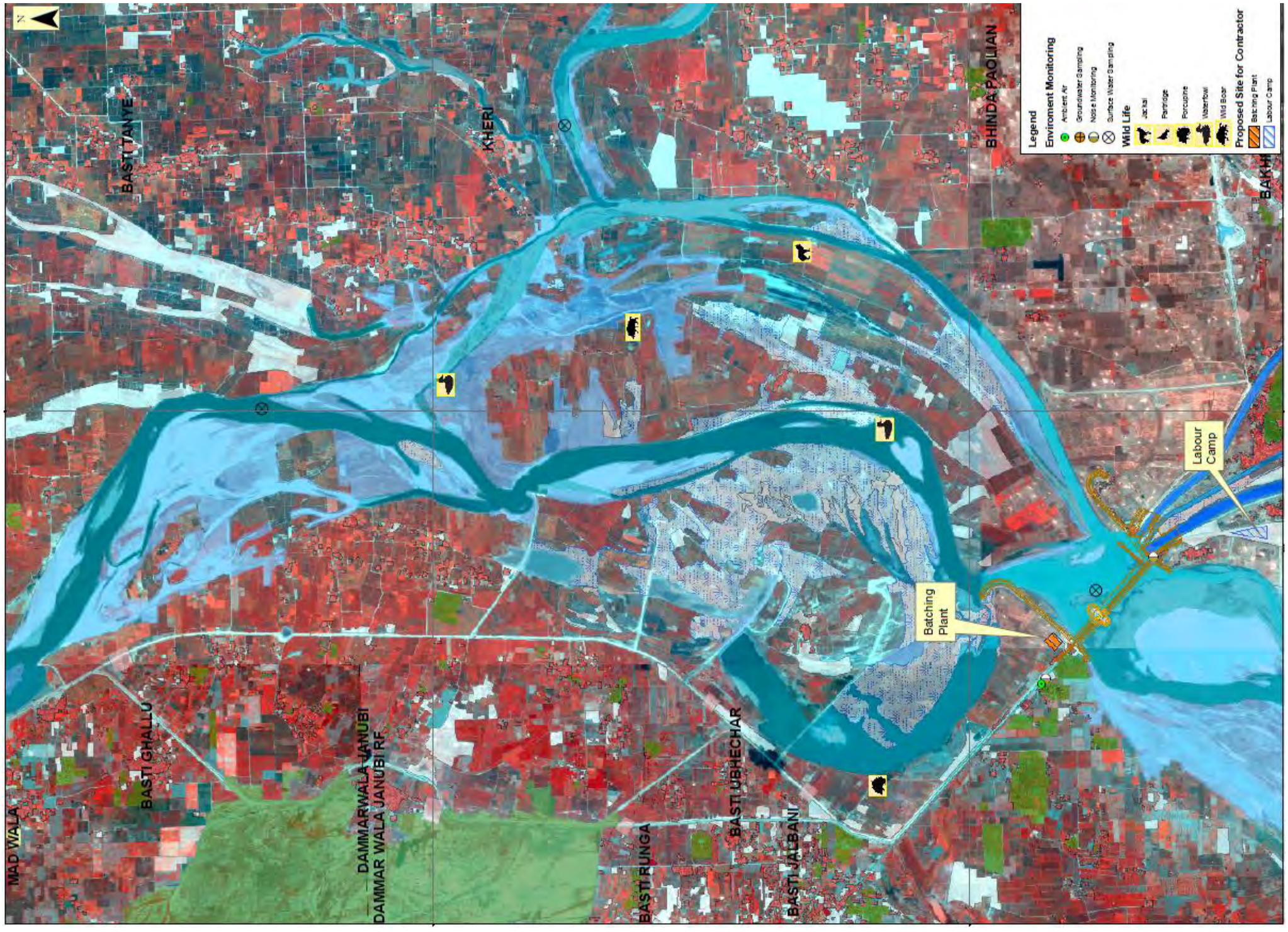

Figure 1-3 Environmental Study Area Map

2. LEGAL AND ADMINISTRATION FRAMEWORK POLICY

2.1 GENERAL

29. This chapter provides an overview of the policy framework and national legislation and international obligations that apply to the proposed Project. The Project is expected to comply with all national legislations and Asian Development Bank Safeguards Policy relating to environmental and social issues, and to obtain all regulatory clearances required.

2.2 REGULATORY REQUIREMENTS IN PAKISTAN

30. Pakistan Environmental Protection Act (PEPA), 1997 is the primary legislation which applies in Environmental Assessment studies in Pakistan. Under section 12 of PEPA 97, a project falling under any category specified in Schedule I (SRO 339(1)/2000) require the proponent to file an IEE with the concerned Environmental Agency, which in case of Panjnad Barrage is EPA Punjab.

2.3 NATIONAL CONSERVATION STRATEGY

31. The Pakistan National Conservation Strategy (NCS) was approved by federal cabinet in March 1992 and is the principle policy document on environmental issues in the country. The NCS outlines the country's primary approaches towards encouraging sustainable development, conserving natural resources and managing resources. The NCS has 68 specific programmers in 14 core areas in which policy intervention is considered crucial for the preservation of Pakistan's natural and physical environment. The core areas that are relevant in the context of the proposed Project are pollution prevention and abatement, conserving biodiversity and preservation of cultural heritage.

2.4 NATIONAL ENVIRONMENTAL POLICY

32. The National Environmental Policy provides an overarching framework for addressing the environmental issues facing-Pakistan, particularly pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification, natural disasters and climate change. It also gives directions for addressing the cross sectoral issues as well as the underlying causes of environmental degradation and meeting international obligations. The policy provides broad guidelines to the Federal Government, Provincial Government, Federally Administrated Territories and Local Government for addressing environmental concerns and ensuring effective management of their environmental resources.

2.5 GUIDE LINE FOR ENVIRONMENTAL ASSESSMENT

33. The Pak-EPA has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of development projects. The guidelines relevant to the proposed Project are listed below:

2.5.1 Guidelines for the Preparation and Review of Environmental Reports, Pakistan Environmental Protection Act, 1997

34. The guidelines, targeted at project proponents, specify:

- The nature of the information to be included in environmental reports

- The minimum qualification of the EIA/IEE conductors appointed
- The need to incorporate suitable mitigation measures at every stage or project implementation
- The need to specify monitoring procedures

35. The report must contain baseline data relating to the project area, an interpretation of the data and mitigation measures.

2.5.2 Guidelines of Public Consultation, Pakistan Environmental Protection Act, May, 1997

36. These guidelines deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensure their concerns are incorporated in any impact assessment study.

2.6 ENVIRONMENTAL INSTITUTIONS AND THEIR RESPONSIBILITIES

i. Provincial EPA

37. The PID will be responsible for providing the complete environmental documentation required by the provincial EPA and remain committed to the approved project design. No deviation is permitted during project implementation without the prior and explicit permission of the EPA.

ii. Provincial Departments of Forestry and Wildlife

38. The rehabilitation works are expected to involve some clearing of vegetation that exist on PID's land where labor camp and batching plant are to be constructed. Widening and strengthening of the embankments may also involve uprooting of trees. The contractor will inform formally to the Punjab Forest Department and PID, even if these trees fall in the area of PID before undertakes any cutting/uprooting. In order to construct 4 depressed bays at existing junction groyne PID will be responsible for clearing of vegetation, and uprooting of trees and their disposal through auction by public members.

iii. Local Government and Municipalities

39. The PID and its contractors must ensure that the project meets the criteria of district governments as related to the establishment of construction camps and plants, and the safe disposal of wastewater, solid waste, and toxic materials. The details are provided in Waste Disposal Plan. The PID will coordinate and monitor environment-related issues.

2.7 ENVIRONMENT- RELATED STATUTES

- **This section outlines statutes apart from the Pakistan Environmental Protection Act, 1997, which are relevant to the project. The Forest Act, 1927 (Provincial Acts and Rules)**

40. The Act, inter alia, deals with the matters related with protection and conservation of natural vegetation/habitats. In that regard it empowers the concerned agency to declare protected and reserved forest areas and maintaining these. In spite of the fact that it recognizes the right of people for access to the natural resources for their household use, it prohibits unlawful cutting of trees and other vegetation. Cutting trees will require for provision of bypass gated weir and strengthening the embankments work in this Project. The permission is required prior to undertake any tree cutting from the area under the charge of Forest Department of

Punjab province. The tree belts along canal sides belong to forest department under the Forest Act, 1927 and are managed under Canal Side Plantation Rules, 1960. 55 trees are likely to be uprooted for the construction of depressed bays at junction groyne. It is recommended to plant 5 new trees for each tree uprooted for project implementation.

- **Government of Punjab, Forestry, Wildlife, Fisheries and Tourism Department (Notification No. FOFT (EXT) VIII. 17/96 Dated 1998**

41. In Punjab, should the number of trees to be felled for a project exceed 100, or if the project falls within the jurisdiction of more than one district, a committee comprising the Commissioner of the division covering the districts, the Conservator of Forests, and the Superintending Engineer of the PID must accord their approval.

- **Provincial Wildlife (Protection, Preservation, Conservation and Management) Act, Ordinances and Rules**

42. In addition to empowering provincial wildlife department to establish game reserves, parks, and wildlife sanctuaries, these acts regulate the hunting and disturbance of wildlife. This law will help in eliminating any trespassing into protected areas.

- **Antiquities Act, 1975**

43. The Antiquities Act relates to the protection, preservation and conservation of archaeological/historical sites and monuments. There are no archeological sites or cultural heritage site inside or near the project area. Nevertheless if there is chance find during the construction phase this law would provide due guidance.

- **Provincial Local Government Ordinances, 2001**

44. These ordinances, issued following the devolution process, establish regulations for land use, conservation of natural vegetation, air, water, and land pollution, the disposal of solid waste and wastewater effluents, as well as matters related to public health and safety. This law will help as and when a participatory management of irrigation system becomes the order of the day.

- **Factories Act, 1934**

45. The clauses relevant to the project are those that are related with the health, safety and environment (HSE) and welfare of workers, disposal of solid waste and effluent, and damage to private and public property. The Factories Act also provides regulations for handling and disposing of toxic and hazardous materials. There are no factories / industries inside or around the Project area. However, indirectly the factories and industries contributing pollution into Chenab and Sutlej rivers become a matter of concern for water behind the rehabilitated Panjnad Barrage.

- **Land Acquisition Act, 1894**

46. Land Acquisition Act (LAA), 1894 is the primary law governing land acquisition in Pakistan. For the acquisition of land, the above-mentioned Act, rules and regulations are followed whether the acquisition is for Government of Punjab or any other agency. Up to this stage no permanent land acquisition has been anticipated in the design of the project. Should there be a need for temporary acquisition, this law would be of help.

2.8 FIDIC CLAUSES

47. The size and nature of the work to be undertaken for rehabilitation and modernization of Panjnad Barrage is such that it is expected to involve international contractor therefore following FIDIC clauses have been considered to address the environmental aspects of the project:

Clause 8.2 Site operation and methods of construction
Clause 19.1 Safety, security of environment in general
Clause 27.1 Fossils
Clause 42.1 Possession of site and access thereto
Clause 42.2 Right of ways and facilities in the project area

2.9 ASIAN DEVELOPMENT BANK GUIDELINES

48. The Asian Development Bank's Environmental Safeguard Policy 2009 requires that environmental considerations be incorporated in to ADB operations to ensure that the project will have minimal environmental impact and be environmentally sound.

The following guidelines shall be adopted:

- **Environmental Category**

49. According to ADB Environment Policy, projects are to be categorized in to the following environmental categories; A, B, or C as given in the table below. At any stage the category can be changed with the approval of the chief compliance officer if further studies and investigations reveal that the projects potential impacts are worse, minimal or negligible.

ADB Environmental Categories
Category A: "Projects with potential for significant adverse environmental impacts." This is applicable in case mega projects causing global or at least regional impacts. This type of project requires a first class EIA to be produced and implemented. This category consider with Category A of the EPA 1997.
Category B: "Projects judged to have some adverse environmental impacts, but of lesser degree and/or significance than those for category A projects."
Category C: Projects unlikely to have adverse environmental impacts.

50. Category B is applicable in case of projects with localized and mitigable impacts. Panjnad Barrage is not a new mega scale project. It is a rehabilitation and repair of an already existing structure without causing change in pond level behind the barrage. All impacts shall be local, limited and mitigable. Such projects according to ADB Safeguards Policy Statement 2009 require an IEE.

2.10 NATIONAL ENVIRONMENTAL QUALITY STANDARDS (NEQS) 2000

51. The NEQS 2000 of EPA under Environmental Protection Act, 1997 specify the following standards:

1. Maximum allowable concentration of the pollutants (32 parameters), in emission and liquid industrial effluents discharge to inland water (NEQS 2000)
2. Maximum allowable concentration of pollutants (two parameters), in gaseous emission from vehicle exhaust and noise emission from vehicles (NEQS 2009)
3. Maximum allowable limit for ambient air quality (NEQS 2010)
4. Maximum allowable limits for drinking water quality (NEQS 2010)

52. These standards apply to the gaseous emission and liquid effluents discharged by campsite and construction machinery. The standards for vehicles will apply during the construction as well as operation phase of the project. Precise standards for air quality are not available under NEQS, 2000. The National Environmental Quality Standards (NEQS) 2000 is included in Appendix 2.1.

2.11 INTERNATIONAL CONVENTIONS

53. Pakistan is signatory to a number of International Conventions, Protocols and Understandings relating to the environment. Those relevant to the project are described in the following paragraphs.

- **Convention on Biological Diversity**

54. The Convention of Biological Diversity was the outcome of the “Earth Summit” held in Rio-de-Janeiro in 1992. The Convention binds the signatories to respect, protect and conserve the earth environment and bio-diversity through sustainable use of natural resources. In all development projects in Pakistan the protocols of this convention are respected in letter and spirit.

- **Ramsar Convention**

55. The Convention on Wetland of International Importance, especially as Waterfowl Habitats held in Iran in 1972 at village Ramsar in Iran, places an obligation on the signatories to protect habitats of migratory waterfowl. Panjnad Barrage is not a notified Ramsar site but as additional measures, Ramsar spirit shall be maintained during the construction phase of the project.

- **Bonn Convention**

56. The Convention on the conservation of migratory species of wild animals was held in Bonn in 1979. The Convention broadens the scope of Ramsar to include migratory species other than water fowl. Not being a Ramsar site, this protocol is not obligatory for Panjnad Barrage. But it will be respected during construction phase to the extent that no damage is caused to habitat of any species.

- **Koyoto Protocol**

57. The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which sets binding obligations on its Parties to reduce emissions of greenhouse gases. Kyoto Protocol introduced the Clean Development Mechanism (CDM) to allow developed countries to work in cooperative projects with developing

countries to reduce GHGs emissions. Pakistan deposited its instruments of accession to the Kyoto Protocol in January 2005. The activities at Panjnad Barrage are of temporary nature and will not have significant contribution in greenhouse gases emissions.

3. PROJECT DESCRIPTION

3.1 HISTORY

58. The barrage is located in Tehsil Alipur (District Muzaffargarh) and Tehsil Ahmedpur East (District Bahawalpur). The barrage was constructed in 1925 -1929 with a designed discharge capacity of 450,000 cusec and was re-commissioned in 1932 to increase its design discharge capacity to 700,000 cusec. During Super floods of 1973 and 1992 breaches took place in left and right marginal bunds. Over the past eighty years the Barrage has facilitated the flow of irrigation water in three canals; Panjnad (design discharge: 7,769 cusecs), Abbasia (design discharge: 1,064 cusecs) and Abbasia Link (design discharge: 5,600 cusecs) canals which off take from the left bank. The barrage irrigates areas in Bahawalpur and Rahimyar Khan Districts. The three canals collectively command an area of 1.62 million acres.

3.2 NEED OF PROJECT

59. Panjnad Barrage is now 80 years old and in the aging process along with inadequate or deferred maintenance has resulted in general deterioration and damages of its different components like the gates and gearing. The cracks have appeared on floor and piers, the barrage floor has grouting cavities and shotcreting, the divide wall is damaged, and the bela formation reduced the pond capacity. The floods of 1973 and 1992 caused the breaches in left and right marginal bunds and the flood discharge exceeded the barrage design capacity. The distorted flow pattern oblique entry of the river to the barrage partially incapacitates the weir function and any further damage to this barrage can result in colossal losses in the form of total or partial disruption of irrigation supplies, agricultural crops, loss of government revenue, and rehabilitation cost of emergency repairs. The barrage has therefore required rehabilitation and repairs.

60. From statistical analysis the 100 year flood at Panjnad Barrage is estimated 865,000 cusecs against its existing design capacity of 700,000 cusecs. The Punjab Government has given due attention to Panjnad Barrage and has included it in the program of rehabilitation of barrages in Punjab.

3.3 NEED OF STUDY AND PROJECT CATEGORIZATION

61. EIA is mandatory according to the Pakistan Environmental Protection Act (PEPA-1997). As provided in Section 12 of the Act:-“No proponent of a project shall commence construction or operation unless he has filed with the Federal Agency an initial environmental examination, or where the project is likely to cause an adverse environmental effect, an Environmental Impact Assessment, and has obtained from the Federal Agency approval in respect of thereof.”

62. According to section 12 of PEPA and Review of IEE/EIA Regulations, 2000 the project falls under category E(2) of schedule II, i.e. “Water management, dams, irrigation and flood protection.”

63. Category B is applicable in case of projects with localized and mitigable impacts. Such projects according to ADB require only an IEE and EMP to be filed. However, as per PEPA, 2012, EPA requires an EIA for such projects falling under category B (schedule II) of the Review of IEE/EIA Regulations, 2000. Since the PEPA, 2012 is a superseding law and the proposed project seeks approval from EPD under the Act, an EIA has been prepared to ensure compliance with the local legal requirement. The proposed project is irrigation and drainage

project. It includes rehabilitation and repair of an already existing structure without causing any permanent change in the surrounding environment. All impacts shall be local, limited and mitigable.

3.4 PROJECT ALTERNATIVES

64. The analysis of alternatives for the project is a vital part of the EIA process as it gives the opportunity to review and assess different ways of meeting the project objectives so that the environmental impact of the project is minimal. The following options/alternatives were analyzed for strengths and weaknesses of the proposed project;

- No project option (worst case scenario)
- Adding 11 bays on the right side without raising Highest Flood Level (HFL)
- Provision of bypass gated weir
- Construction of 4 nos. of additional depressed bays utilizing the existing junction groyne with increased HFL.

65. The last option is proposed to be adopted for it is considered to be best in respect of environmental, social and technical aspects and ease of construction work.

66. Detailed description of the project alternatives supported with corresponding strengths and weaknesses of the proposed options is included in Chapter 5.

3.5 SCOPE OF WORK

67. The scope of work will include repair of the barrage structure including barrage floor, arrangements for safe passage of 100 years flow, replacement of road bridge deck of the barrage, repair/replacement of regulation gates, gearing and hoisting devices, modernization of barrage structure, installation of new vibrating wire piezometers and trimming of the shoals (bela) in the pond area. The project has two main components viz; a) Rehabilitation of the existing Barrage b) provision of additional depressed bays at place at existing junction groyne to increase the barrage discharge capacity.

a) Rehabilitation of existing barrage include following

1. Rehabilitation of gates and gearing of canal head regulators and the barrage
2. Adding upstream sheet pile in Left pocket in front of bay no. 3 and 4
3. Removal of the bela and extension of junction groyne
4. Grouting cavities beneath the barrage floor and shotcreting of the floors
5. Rehabilitation and construction of damaged friction blocks
6. Restoring the damaged divide wall
7. Sealing cracks on floors and piers
8. Improvement of pressure pipe monitoring system
9. Raising and strengthening of guide banks and marginal bunds
10. Strengthening and raising of upstream and downstream training works and replenishment of stone aprons

b) Flood Management of additional discharge of 165,000 cusec

68. For controlled releasing of the flood above the 700,000 cusec 4 nos. of additional depressed bays have been proposed to be constructed utilizing the existing junction groyne.

3.6 EXISTING CONDITION OF THE BARRAGE

69. At the time of completion of Barrage structure in 1931 the barrage comprised of:

Stoney Gate Equipment

70. A total number of forty seven (47) bays constitute the barrage including thirty three (33) bays of Main Weir and fourteen (14) bays of Annexe Weir. Vertical Lift Stoney Gates having single leaf have been installed at all the forty seven (47) bays of the barrage. The span of each gate leaf is 60 ft and size of each gate is 62 ft – 10 in wide x 13 ft – 6 in high. All the gates have upstream skinplate reinforced with bowstring steel angle iron trusses in horizontal position at downstream side. The gates have riveted structure and bottom metallic seals. Staunching pipes have been provided for side sealing. Guide groove of gates are made of cast iron and have been embedded in the concrete.

Canal Head Regulator

71. There are three head regulators of off-taking canals from the barrage namely Panjnad Canal, Abbasia Canal and Abbasia Link Canal. There are 12 bays of Panjnad Canal, 2 bays of Abbasia Canal and 6 bays of Abbasia Link Canal.

72. Head regulators of the three (3) off-taking canals i.e. Panjnad Canal, Abbasia Canal, Abbasia Link Canal are equipped with the following gate equipment:

Canals	Bays (Nos.)	Span (ft)	Type of Gate	Type of Hoisting System
Panjnad Canal	10	26	Radial Gate	Stem
	2	18		
Abbasia Canal	2	20	Slide Gate	Stem
			Fixed Wheel	Rope & Drum
Abbasia Link Canal	6	25	Fixed Wheel	Rope & Drum

Waterways

73. A main weir consisting of 33 standard bays and 14 under-sluice bays of 60ft each with crest level 325ft amsl.

Divide Wall

74. There is only one 960 ft. long divide wall at Panjnad Barrage that separates the main weir from left pocket for the three off taking canals. It was originally constructed as 800 ft. long stone masonry wall for the Panjnad and Abbasia canals. Its height is 26 ft. from the top of stone apron placed at RL. 320.0 ft. The width of this wall is 5.0 ft. for the upper 1/3rd height that enlarges to 7.5 ft. (middle 1/3rd height) and then to 13 ft. at the base. It is founded on well foundations and is protected with stone apron against local scour.

75. Rusting/damage of gabion bars, loss of packed stone from gabions, differential settlements of gabions with full height separation cracks and big cavities and pits in the foundation were experienced in the past. Besides regular maintenance and expenditure on these portions there is always a serious threat to their stability. It is therefore recommended to rebuild the gabion sections of damaged and extended divide wall and replace them with

reinforced concrete gravity wall on raft foundation properly protected with steel sheet piles and stone aprons.

Fish Ladder

76. One fish ladder has been provided along left side of the divide wall. The functioning of the fish ladder is reported satisfactory hence no substantial remodeling appears to be necessary.

Guide Bank

77. At present guide banks on both upstream and downstream sides are in satisfactory condition with their lengths 3600 and 606 ft. respectively. Both upstream guide banks are 3600 ft. long and are nearly in parallel alignment with curved armored head straight whereas the downstream guide banks are 606 ft. each and are having divergent alignment. The noses of these banks are heavily armored to ensure safety against severe attacks of the river. The Top level of guide bunds is at RL 348.00.

Road Bridge

78. The expansion joints in the deck slab at various locations of the road bridge are damaged which are not fully effective and need necessary repair and rehabilitation. The remaining components of the bridge including footpath, structural deck, pre-stressed girders and railings are in good condition and quite serviceable for future use except the deck.

Barrage Piers

79. All piers 7 feet wide in the Main Weir, Annexe Weir and the left Pocket are constructed in stone masonry and, in general show no noticeable sign of distress, cracking or structural problem except the local wear tear and erosion of the piers.

Junction Groyne between Main and Annexe Weirs

80. The barrage was constructed initially for 450,000 cusecs capacity with 33 bays. Junction Groyne 250 feet wide and 300 feet long was constructed on the right end of main weir replacing RGB and on its right annexe weir was constructed having 14 bays with a discharge capacity of 250,000 cusecs with a new RGB. The main function of this structure was to facilitate its construction during its operation, provide left abutment for annexe weir and afterward create a separator between two structures. The function of structure is satisfactory.

3.6.1 Barrage Components

(a) Barrage

• Design discharge (Cusecs)	700,000
• Total width between abutments (ft)	3,400
• Clear water way (ft)	2,820 (47 bays of 60 ft width each)
• Minimum U/s flood level (ft)	R.L. 341.50
• Minimum D/s flood level (ft)	R.L. 340.30
• Pond level – normal (ft)	R.L. 337.50
• Crest level(ft)	R.L. 325.00

(b) Left Pocket, Main Weir and Annexe Weir

	Left Pocket Bay 1 to 4	Main Weir Bay 5 to 33	Annexe Weir Bay 34 to 47
• Designed capacity (Cusecs)	450,000		250,000
• Weir crest level (ft)	R.L. 325.00	R.L. 325.00	R.L. 325.00
• U/s floor level (ft)	R.L. 320.00	R.L. 320.00	R.L. 320.00
• D/s floor level (ft)	R.L. 316.00	R.L. 316.00	R.L. 315.00
• U/s floor length (ft)	150.50	150.50	108.50
• Impervious (ft)	90.00	94.75	48.00
• Pervious (ft)	60.50	55.75	60.50
• D/s floor length (ft)	156.50	156.50	166.50
• Impervious (ft)	46.50	46.50	39.00
• Pervious (ft)	110.00	110.00	127.50
Depth of Cutoffs / Sheet Piles			
• Upstream (ft)			20.00
• Intermediate (ft)	30.00	30.00	20.00
• Downstream (ft)	25.50	25.50	20.00
Gate Type	*Manually Operated Vertical Gates*		
• Maximum designed head (ft)	19.50		
• Bottom level- fully up (ft)	R.L. 340.50		
• Bottom level- fully down (ft)	R.L. 325.00		
• Top level- fully down (ft)	R.L. 338.50		
Divide Wall			
• Top Level (ft)	R.L. 346.00		
• Top width (ft)	7.00		
• Length (ft)	Originally 800.00 but now 960.00		
Road Bridge			
• Top Level (ft)	R.L. 352.00		
• Span of one bay C/C (ft)	66.00		
• Width including footpath (ft)	28.00		

(c) Guide Banks

	U/s Left	D/s Left	U/s Right	D/s Right
• Length (ft)	3613.00	605.00	3613.00	605.00
• Top Level (ft)	R.L. 348.00	R.L. 343.00	R.L. 348.00	R.L. 343.00
• Top width (ft)	60.00	30.00	60.00	30.00
• Freeboard (ft)	6.50	3.0	6.50	3.0
• Side slope (H:V)	2:1	2:1	2:1	2:1

(d) Marginal Bund

	Left Marginal Bund (LMB)		Right Marginal Bund (RMB)	
	Bund	Wetting Channel	Bund	Wetting Channel
• Length (canal mile)	13.00	13.00	13.00	13.00
• Top Level (ft)	R.L. 350.30	R.L. 347.30	R.L. 350.30	R.L. 347.30
• Top width (ft)	20.00	6.00	20.00	6.00
• Freeboard (above HFL 1973)	5.00	2.00	5.00	2.00
• Designed depth of channel (ft)		3.00		3.00
• Side slope (H:V)				
River side	3:1	2:1	3:1	2:1
Land side	4:1	2:1	4:1	2:1

(e) Canal Head Regulator

Item	CANALS		
	Panjnad	Abbasia	Abbasia Link
• Capacity (Cusecs)	7,769	1,064	5,600
• Crest level RL (ft)	332.5	330	330
• Floor RL (ft)	320.00	320.00	325.90
• Full supply level RL (ft)	335.70	336.10	335.40
• No. of Bays	12	2	6
• Width of each Bay (ft)	18 (2 No.) 26 (10 No.)	20	25
• Pier thickness (ft)	4	4	
• D/S Floor level RL	324.00	328.70	323.00

3.7 DESCRIPTION OF THE PROJECT

81. The project aims at repairing and upgrading water resources and irrigation infrastructure at the Panjnad Barrage. The project is designed to address the following issues:

- The approach of the river to the barrage is oblique, which partially incapacitates the weir function and makes/renders the marginal bunds unsafe in high floods.
- High floods caused heavy damages through breaches in the marginal bunds because the barrage capacity is less than the 100 years return flood discharge. There is a need for the enhancement of barrage capacity
- The decking of the road bridge has been deteriorated and become risky for present traffic requirements.

3.7.1 Components of the Project Activity

82. The works include both civil and mechanical/electrical works. A construction schedule is included in Appendix 3.1. The components of work are as follows:

Civil Works

- Provision of 4 nos. of additional depressed bays by utilizing/at the place of the existing junction groyne
- Raising and strengthening of guide banks and marginal bund according to new HFL. New anticipated HFL levels along RMB are provided in Appendix 3.2
- Adding upstream sheet pile in left pocket
- Grouting cavities beneath the barrage floor and shotcreting of the floors
- Rehabilitation and construction of damaged friction blocks
- Restoring damaged divide wall
- Sealing cracks on floors and piers
- Partial removal of the bela and
- Development of a public park at proposed available state land, shown in figure 3.1.

Mechanical/Electrical Works

- Rehabilitation of gates and gearing of canal head regulators and the barrage
- Improvement of pressure pipe monitoring system

Existing River Training Works

83. No new river training work is recommended. The existing river training works and flood embankments are to be raised for (increased) 100 years design flood.

Recommendations for Rehabilitation

Sr. No.	Structure	Recommendation
A.	**Main Barrage**	
1	Sill Beams	New sill beams with stainless steel sill plate will be installed.
2	Staunching Pipe	New L-type rubber seals shall be installed on the sides of all gates.
3	Gate Leaf Assembly	Replacement of 3.5 ft bottom portion of each gate skin plate along with end girder and replacement of one (1) number bottom truss of all gates will be carried out. Gates will be completely sand blasted and painted with epoxy paint.
4	Bottom Seal	Wedge type rubber seals will be installed at bottom of all gates.
5	Hoist	Necessary modifications will be carried out to convert the existing system into electrically operated system. The position indicators will be repaired. Machines will be overhauled and repainted.
6	Hoisting Deck	New galvanized steel chequered plate will be installed in place of wooden planks.
B.	**Panjnad Canal**	
1	Sill Beams	New stainless steel sill beams will be installed
2	Gate Leaf Assembly	Replacement of 2 ft bottom portion of each gate skin plate along with reinforcing members will be carried out. All Gates will then be sand blasted and painted with epoxy paint also
3	Gate Seals	New four way sealing system will be installed. Wedge type rubber seals will be installed at the bottom, P-type rubber seals will be installed at sides and J-type rubber seals will be installed at top
4	Counter Weights	Minor repairs will be carried out and counter weights will be cleaned and painted
5	Hoist	Necessary modification will be carried out to convert the system into electrically operated system. Machines will be overhauled and repainted
6	Hoisting Deck	New galvanized steel chequered plate will be installed in place of wooden planks
C	**Abbasia & Abbasia Link canals**	
1	Sill Beams	New sill beams with stainless steel sill plate will be installed
4	Counter Weights	Minor repairs will be carried out and counter weights will be painted
5	Hoist	Necessary modification will be carried out to convert it into electrically operated system. Machines will be overhauled and repainted

Monitoring and Control

- **Multi-Level Piezometer**

84. The multi-level piezometers shall be installed to monitor the uplift pressure under the barrage.

- **The Video Surveillance Subsystem**

85. All vehicles and pedestrians crossing the entry/exit points of the barrage and each gate of the barrage including the canal gates shall be monitored and video logs of their entry/exit shall be maintained at the Control Room (CR) and other indicated locations on video surveillance server.

Additional Depressed Bays

86. The work includes construction of 4 nos. of depressed bays of 56 ft wide each and separated with 4 ft thick piers at the existing junction groyne with increased HFL.

3.7.2 Temporary Works

87. The temporary structures include construction of coffer dam topped with additional diversion road to facilitate the traffic movement at Uch-Alipur Road during construction of additional depressed bays as shown in Fig. 3.2. It will be a single-lane metalled road 50ft (30ft for public traffic and 20 ft for construction work activities) wide at the top with a divider. The length of the proposed diversion will be 2580 ft.

3.7.3 Public Park

88. The requirement of developing a recreational spot at the barrage was initiated during stakeholder public consultation. Developing new public park is proposed at the available state between Panjnad Canal and Abasia Canal.

3.8 LABOR CAMPS

89. It is envisaged that the Project will attract about 1930 skilled/unskilled (62% unskilled, 31% semi-skilled and 7% skilled) labour. It should be ensured that maximum labor arranged locally however the majority of the skilled labour working on site likely to be migrated from other part of the country. It is the Contractor's contractual obligation to provide a labour camp, consultant's and employer offices and Engineer residences and offices on site. There is Government land available near the Panjnad Barrage which could be utilized for setting up the Contractor's facilities i.e. labour camp, batching plant, work base area, waste disposal site etc. and no private land will be acquired for this purpose. The Contractor's camp and labour camp will be a permanent structure which could be used by other institutions e.g. irrigation, police, forces etc. at the completion of the Project. The suitable locations for the Contractor's facilities are indicated on Figure 3.1. The land of recommended sites will be arranged by the PID for the Contractor.

3.9 WORK BASE AREA

90. There is ample PID land available on site for establishing the work base area. The work base area and all the access roads to the area can be within the PID's land. No private land acquisition is anticipated for establishing the work base area. Modification and maintenance of

the surface of the bunds and access roads will be undertaken to ensure dust free environment of the area. The local labor will access the work base area through transportation which may be provided by the contractor.

3.10 MATERIAL REQUIREMENT

91. The main types of materials required for the execution of the proposed work include:

3.10.1 Civil Works

92. Civil Work will include the handling of following material:

Portland cement, stone, coarse aggregate, sand, reinforcement steel, PVC water stops, steel sheet piles, bricks, paint, tube-well equipment, admixtures for concrete, epoxy materials, plasticizers etc. and steel plates, and channels. The anticipated quantities of the material require are:

Material	Units	Approximate Quantity Require
Concrete Cement Sand Aggregate	100 cft bags cft cft	38,415 676,104 169,0260 338,0520
Stone	100 cft	67,248
Steel	100 kg	57,163
Sheet Piles	100 kg	11,363
Clayey Soil (Fill Material)	1000 cft	77,754

3.10.2 Electrical/Mechanical Works

93. Generally following material and equipments will be used in electrical/mechanical work in this project.

- Gates
- Hoisting Systems
- Cable
- Electrical Cables
- Motors
- Gear Box
- Welding Material and Sensors
- Other Electronic Devices

3.11 SOURCE OF MATERIALS

94. The common source of the materials required for civil works is described in Table 3.1.

Table 3-1 Source of Raw Material

Sr. #	Construction Material	Source
1	Earth Material	Available locally, borrowed from the lands temporarily leased by the contractor for the purpose
2	Coarse Aggregate	Coarse aggregates are available at many sources, such as quarries at Sakhi Sarwar (130 km), Margala Hills (580 km) and Sikhanwali at Sargodha (430 Km) The choice will however depend upon the quality and suitability of the material
3	Rip-rap material	Available from quarries at Sakhi Sarwar (130 km) and Sikhanwali (440 km)
4	Sand	Available locally,
5	Water for preparation of concrete	Ample freshwater aquifer is available along the river. The contractor will install tube wells in the area owned by PID. If private tube well is required, the SFA will be signed and the owner will be duly compensated
6	Water for compaction of embankments	Ample source water is available in the river
7	Cement	Portland cement is locally available from the factories situated in Mianwali (460 km), D.G.Khan (115 km), Chakwal (560 km), Islamabad (540 km) etc. However, slag cement and granulated slag are available from Thatta (750 km) and Zeal Pak cement factories in Sindh (750 km)
8	Additives and admixtures for concrete	These materials are available in the country with leading brands like Abepak, Sika, Fosroc and Fospak
9	Reinforcement steel	Grade 60 / Grade 40 reinforcement steel is available from re-rolling mills at Karachi (810 km), Lahore (505 km) and Multan (100 km) with approval of the Engineer
10	Mechanical parts of the Gates	Could be manufactured at Heavy Mechanical Complex at Taxila, Factories at Lahore (505 km) and Gujranwala and /or imported from abroad
11	Steel Sheet Piles	Not available locally and have to be imported (Distance from sea port = 810 km)
12	Interlocks Sealant for Sheet Piles	Available both locally and sheet piles manufacturer abroad
13	Vibrating Wire Piezometers	Not available locally and have to be imported
14	PVC Water Stop	Locally available

3.12 EQUIPMENT AND MACHINERY

It is envisaged that the following equipment and machinery will be required for construction activities:

1	Dozers	17	Welding Rotary
2	Tractors with Water Tankers	18	Welding Transformers
3	Dump Trucks	19	Welding Generator
4	Wheel Loaders	20	Generators
5	Excavators	21	Centrifugal Pumps
6	Tractors with Jack Trolleys	22	Submersible Pumps
7	Grader	23	Diesel Engines for Pumps
8	Water Bouzers	24	Air Compressors
9	Tractors with Water Tank	25	Diesel Tanks
10	Vibratory Rollers (Pad Foot & Plain)	26	Cement Bulk Carriers
11	Plate Compactors	27	Mobile Crane
12	Cranes (capacity 60 tone)	28	Fork Lifter
13	Sheet Pile Hammer	29	Lathe Machine
14	Batching Plants	30	Concrete Mixers
15	Transit Mixers	31	Vehicles
16	Concrete Pump		

95. The equipment will be kept in a plant & equipment yard. The suitable site for the yard is indicated on Figure 3.1.

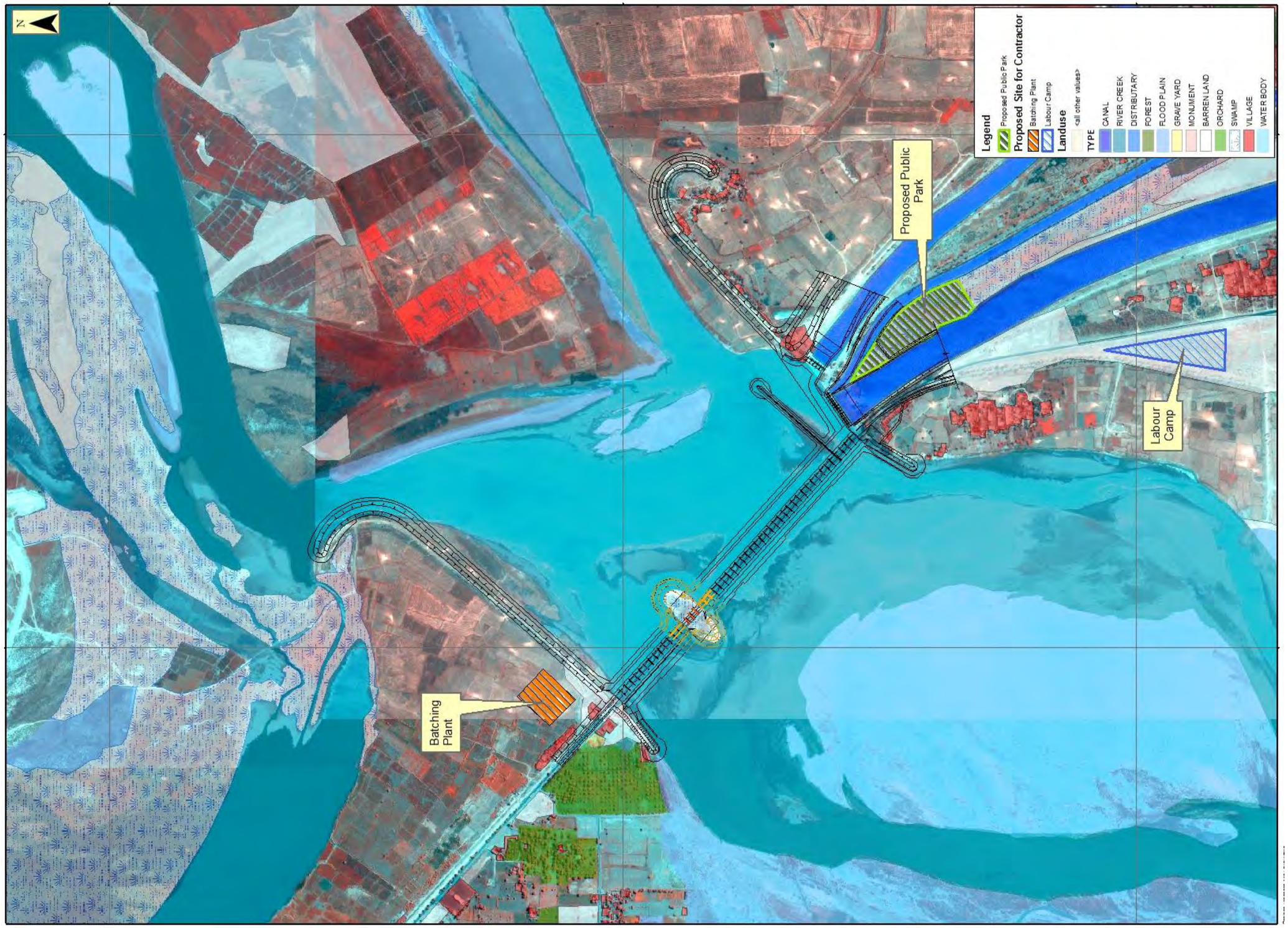

Figure 3-1 Project Layout of Selected Work Scheme

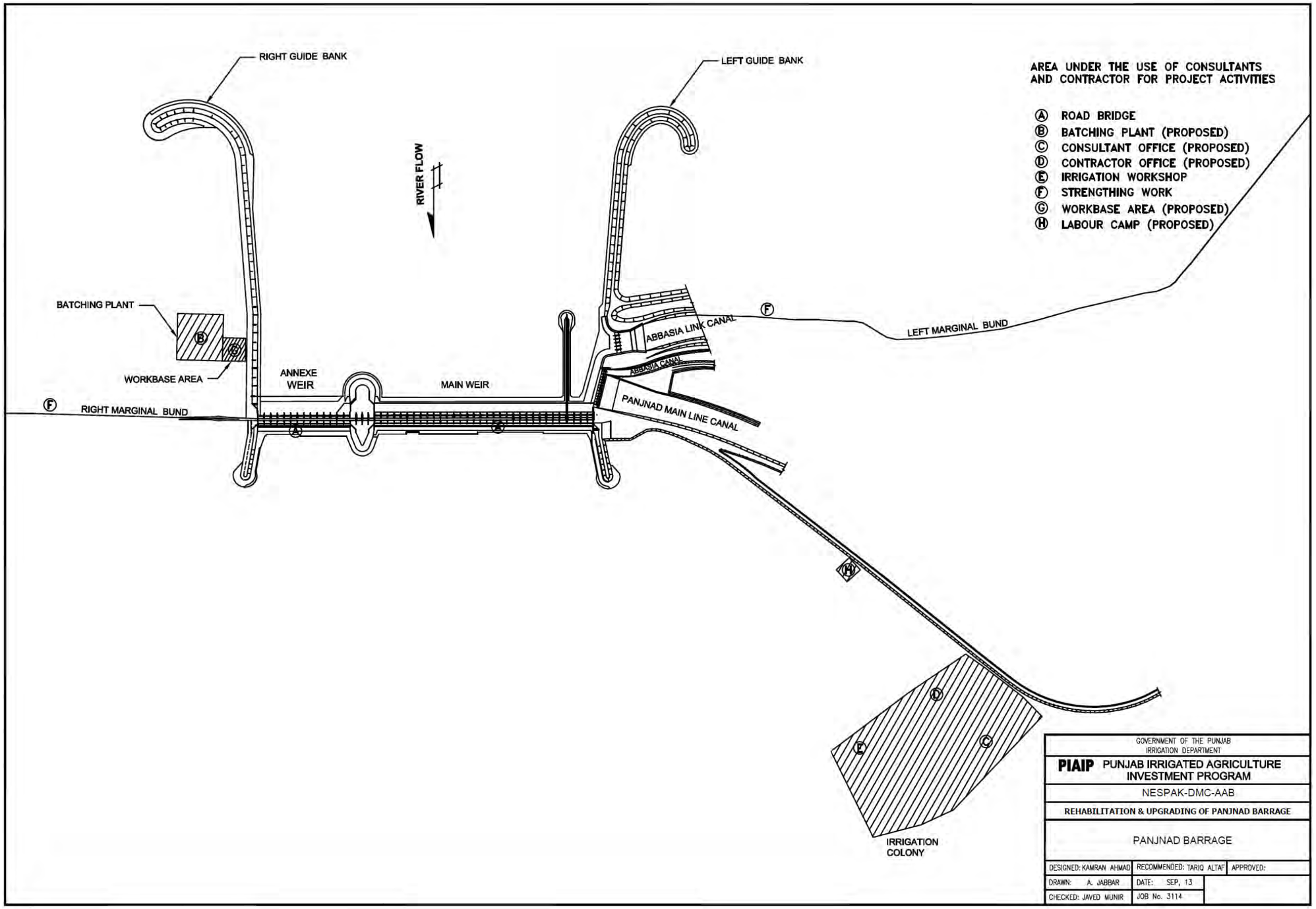

Figure 3-2 Proposed Site Layout Plan

4. BASE LINE CONDITION

4.1 GENERAL

96. The purpose of this chapter is to establish the baseline conditions for the Physical, Biological and the Social aspects of Environment of the project area. This chapter assesses the extent of the Area of Influence (AOI) and describes the relevant environmental conditions of the Study Area. Primary data of the area has been collected by using GIS technology and technical site surveys. Secondary data has been collected from other institutions i.e. Land Reclamation Office, SCARPS Monitoring Organization (SMO), Metrological Department, Forestry, Wildlife and Fisheries Department etc. This will assist in impact assessment and suggesting the appropriate mitigation measures required.

4.2 PHYSICAL ENVIRONMENT

97. The physical environment consists of the environmental parameters covering geology and hydrology of the area, water quality (surface and groundwater), ambient air quality and climatic conditions.

4.2.1 Physiography and Soil

98. The proposed project area is a part of the vast Indus plain. The northern part of district Muzaffargarh includes a portion of the Thal desert. The riverian part of the district can be divided into two parts. The first is a comparatively narrow strip along both the rivers Chenab and Indus, where the summer floods are so high that no Kharif crop can be grown. The soil of this zone is mainly coarse silty sand. Good quality of sand is found along river Chenab and is used in construction industry. Inside the flood zone, in the area where the flood is less violent, both Kharif and Rabi crops are cultivated. Soil of this zone is less coarse and can be broadly classified as silty clay. Water table is generally high in the area and where the natural course of surface water is blocked by railway, road, canal or embankment, the area is waterlogged. Where the water logging has continued for a number of years, saltpeter has rise to the surface and the soil has become unfit for cultivation.

The Project site is located on Indus valley alluvial deposits. The thickness of these alluvial deposits in the Indus Plain has been estimated to be about 1200 ft (365m). The typical deposits are known to generally comprise of Silty Clay/ Clayey Silt at shallow depths and fine to coarse grained, medium to dense sands with Silty Sand/ Sandy Silt at depths below 15 to 20 ft. The bore hole log is provided in Appendix 4.1.

4.2.1.1 Surface Salinity

99. In the event of extended canal closure the saline area will be most vulnerable area in the canal commands. Extended canal closure will not be required in this project. However, areas in saline zones likely to be affected by canal closures are identified and discussed in Chapter 6. A study of surface salinity of the canal command area of Panjnad Canal and Abbasia Canal was undertaken by the SCARPS Monitoring Organization (SMO) and presented in their reports references: SMO Publication No. 39. The main parameters tested in the field were EC and pH.

100. SMO arranged auger holes at suitable sites up to 180 cm depth or to the sloughing material for the study within the canal command area. The percentages of strongly saline (EC >

15ds/m) area found within each canal command areas are summarized in Table 4.1. Considerable area was identified as strongly saline within the Panjnad Canal command area.

Table 4-1 Surface Salinity Statistics

Canal Command	**Non-Saline** (Percentage)	**Strongly Saline** (Percentage)
Panjnad	76%	9%
Abbasia	64%	2.1%

Source: SMO report publication No. 39

4.2.1.2 Seismic Data

101. Due to the continental plate drift of Indian Plate and Asian Plate, Pakistan has been suffered from the devastating earthquakes in past. NESPAK has been developed a Seismic Zoning Map for Pakistan. The whole country is divided into following 5 zones:

Seismic Zone	Peak Horizontal Ground Acceleration
1	0.05 to 0.08g
2A	0.08 to 0.16g
2B	0.16 to 0.24g
3	0.24 to 0.32g
4	>0.32g

Where “g” is the acceleration due to gravity

102. The project area falls within zone 2A as indicated in Figure 4.1. Zone 2A represents area of negligible damage from the earthquake. Design team has considered the possible impacts of earthquake on the barrage structure.

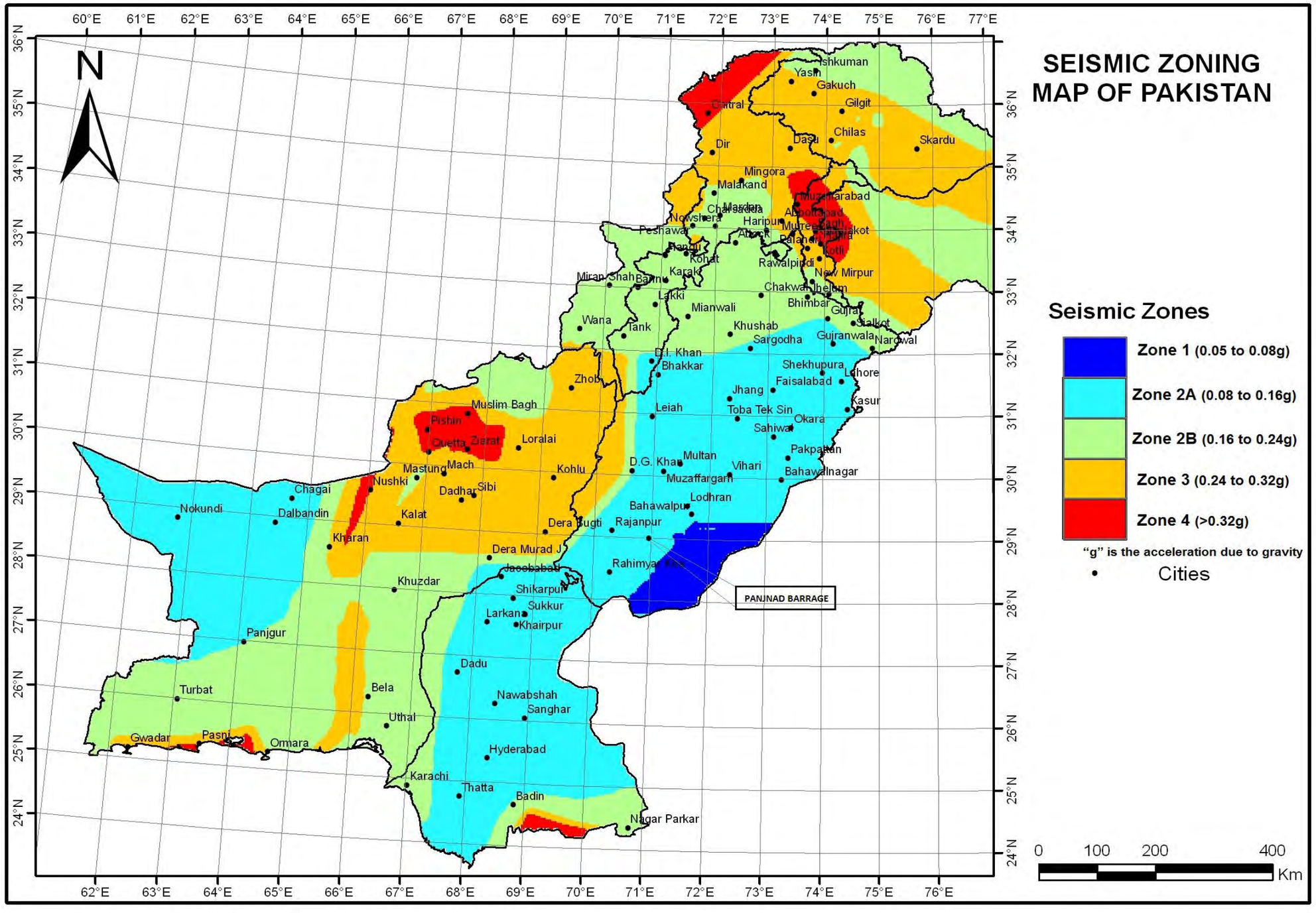

Figure 4-1 Seismic Zoning Map of Pakistan

4.2.2 Climate

103. The meteorological station is located in District Bahawalpur. The data and analysis provided is based on yearly record from the monitoring station managed by Pakistan Metrological Department (PMD). The climate of the area is arid, characterized by long hot summers and shorter cold winters. The summer extends from April to September.

4.2.2.1 Temperature

104. The mean temperature ranged between 40°C to 42°C in summer. May and June are the hottest months during which maximum temperature may rise up to 50°C. The winter lasts from November to February and the minimum temperatures drops at night to as low as 2°C.

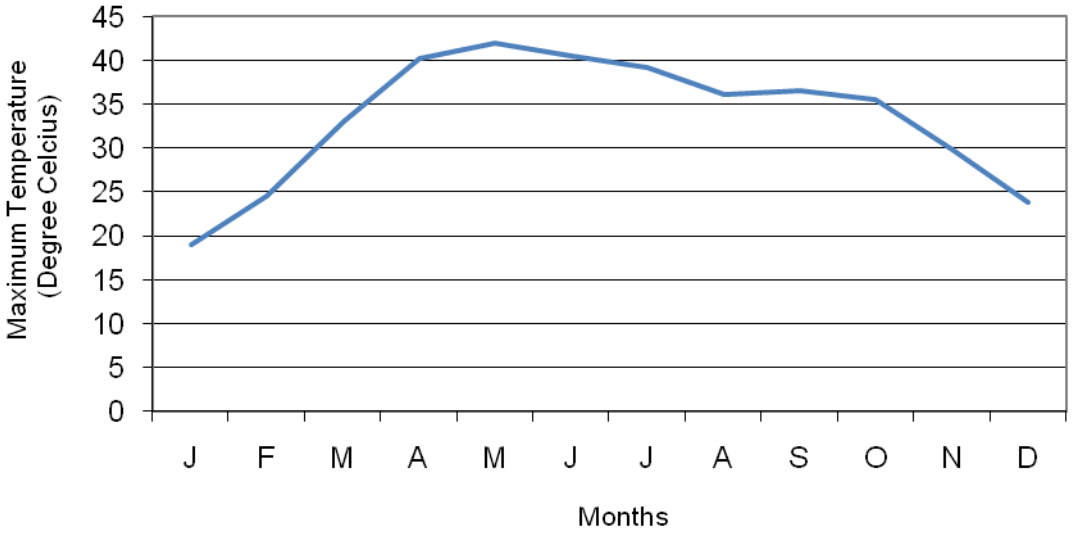

Figure 4-2 Average Maximum Monthly Temperatures, Bahawalpur (2010)

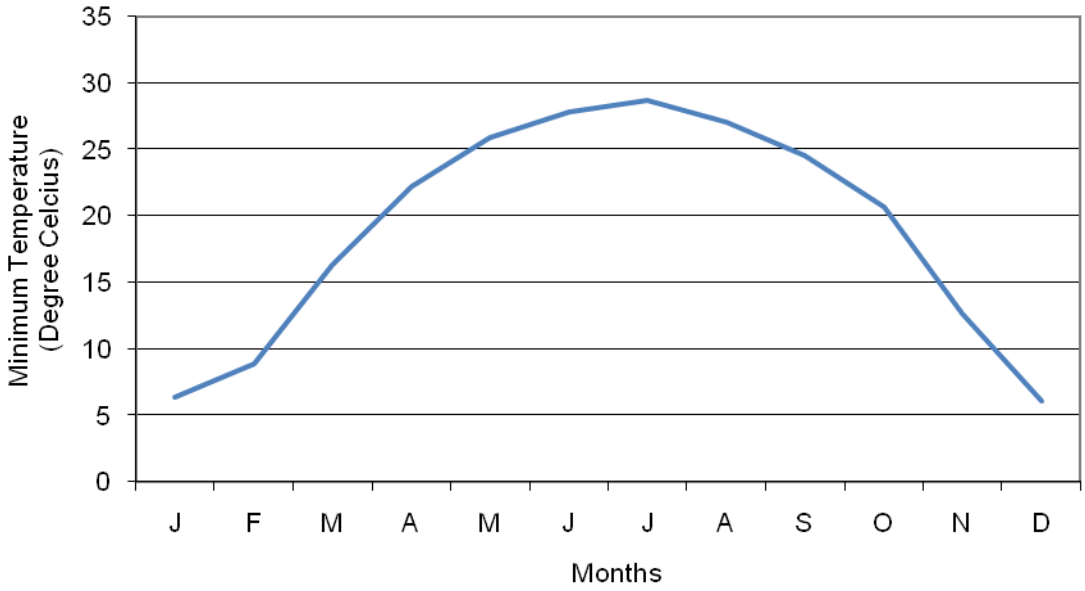

Figure 4-3 Average Minimum Monthly Temperatures, Bahawalpur (2010)

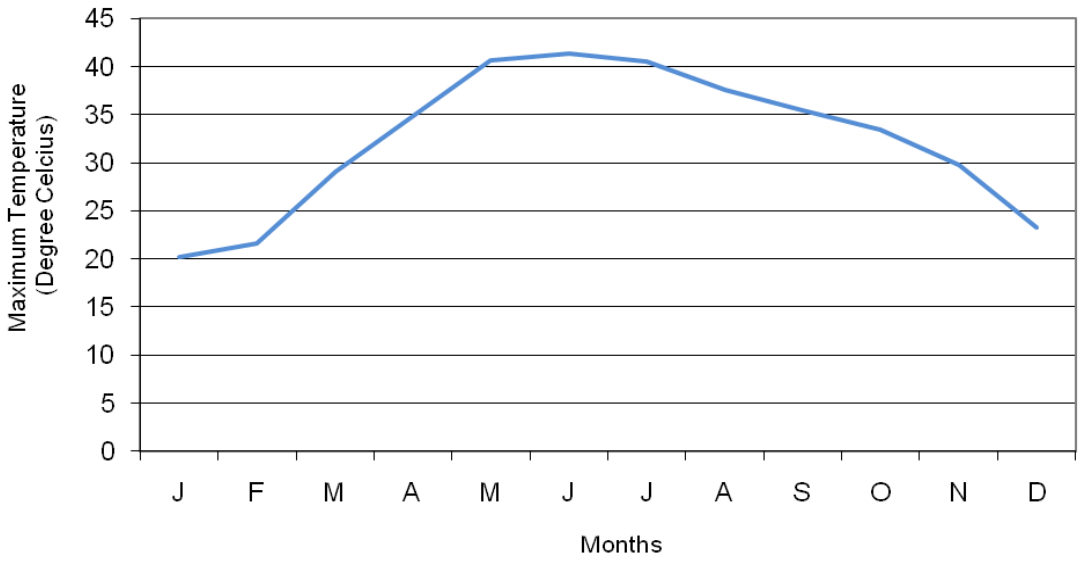

Figure 4-4 Average Maximum Monthly Temperatures, Bahawalpur (2012)

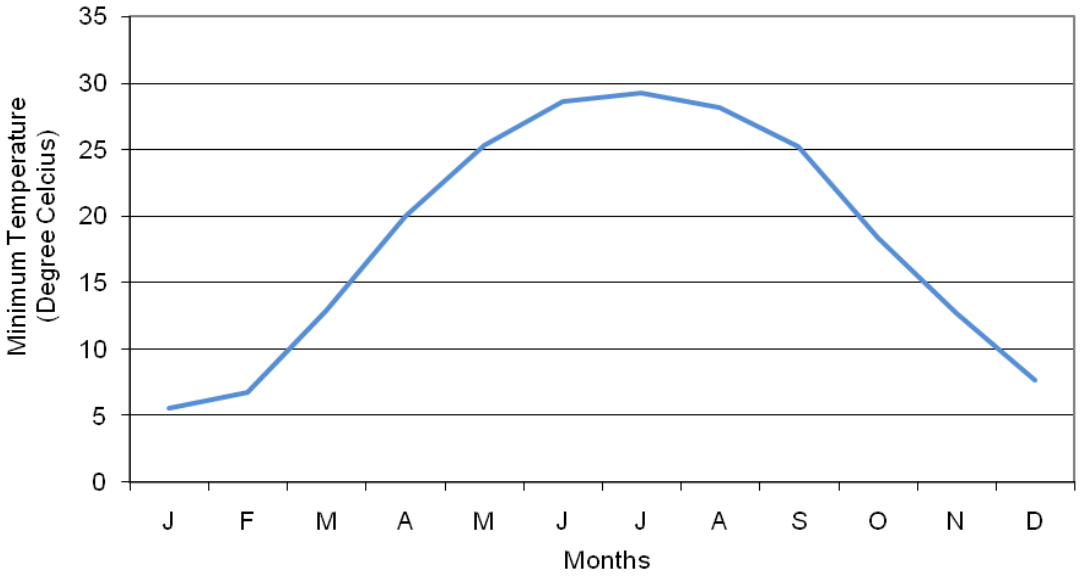

Figure 4-5 Average Minimum Monthly Temperatures, Bahawalpur (2012)

4.2.2.2 Rainfall and Humidity

105. District Bahawalpur receives 21 millimeters average rainfall annually. Most of the rain occurs during monsoon period from July to September. On the whole the rainfall is too scanty and unreliable to be of any agricultural use. The monthly rainfall varies between 0.4 to 55.5 mm. The highest rainfall was recorded during the month of August.

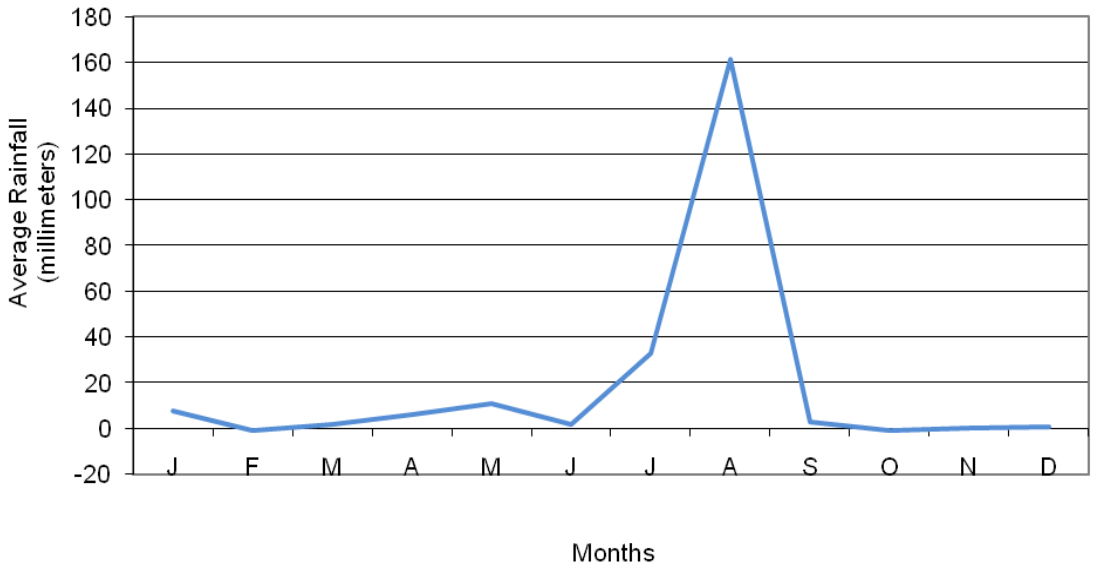

Figure 4-6 Average Monthly Rainfall, Bahawalpur (2010)

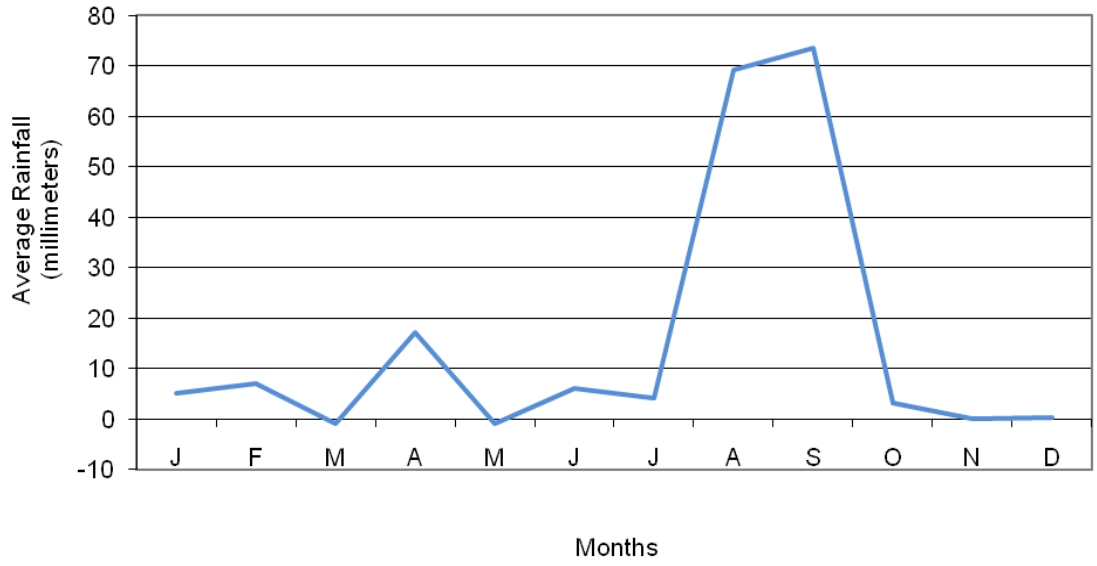

Figure 4-7 Average Monthly Rainfall, Bahawalpur (2012)

106. The average relative humidity was obtained from the Meteorological Department for Bahawalpur. Relative Humidity varies between 38% and 83%. The relative humidity is generally low except during monsoon period.

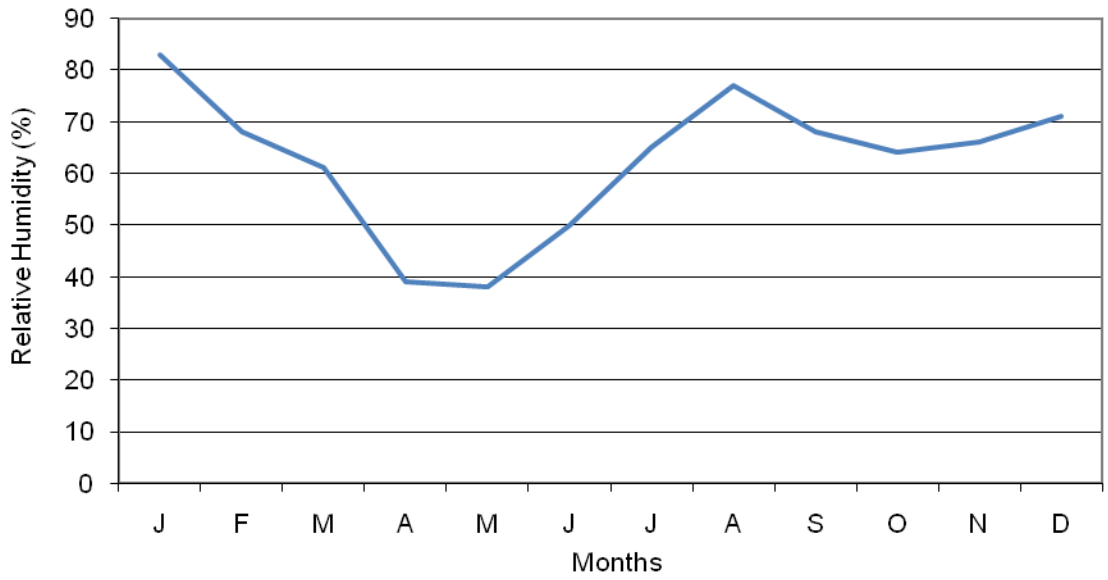

Figure 4-8 Average Relative Humidity, Bahawalpur (2010)

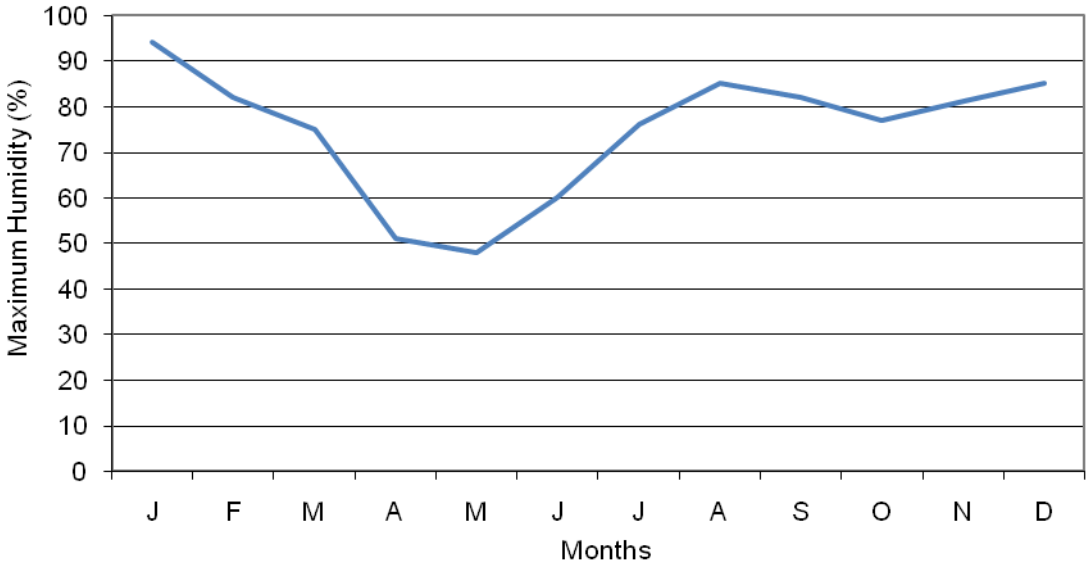

Figure 4-9 Maximum Monthly Humidity, Bahawalpur (2010)

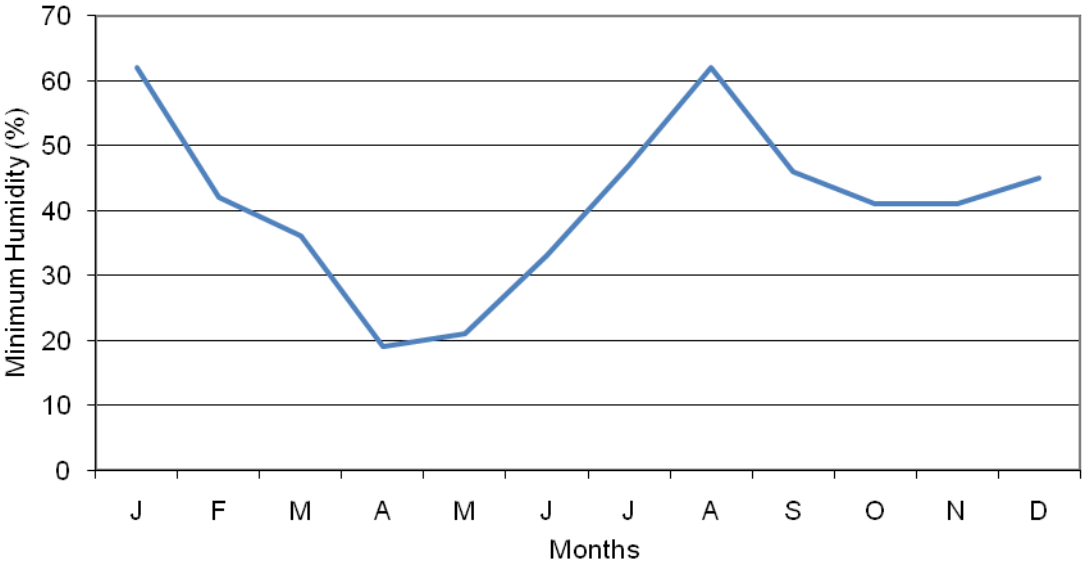

Figure 4-10 Minimum Monthly Humidity, Bahawalpur (2010)

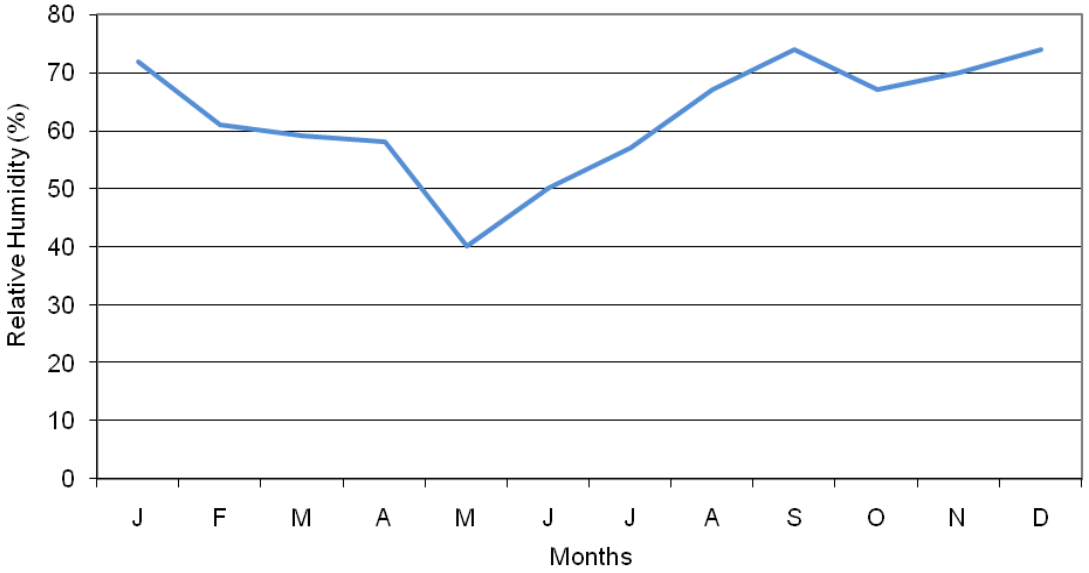

Figure 4-11 Average Relative Humidity, Bahawalpur (2012)

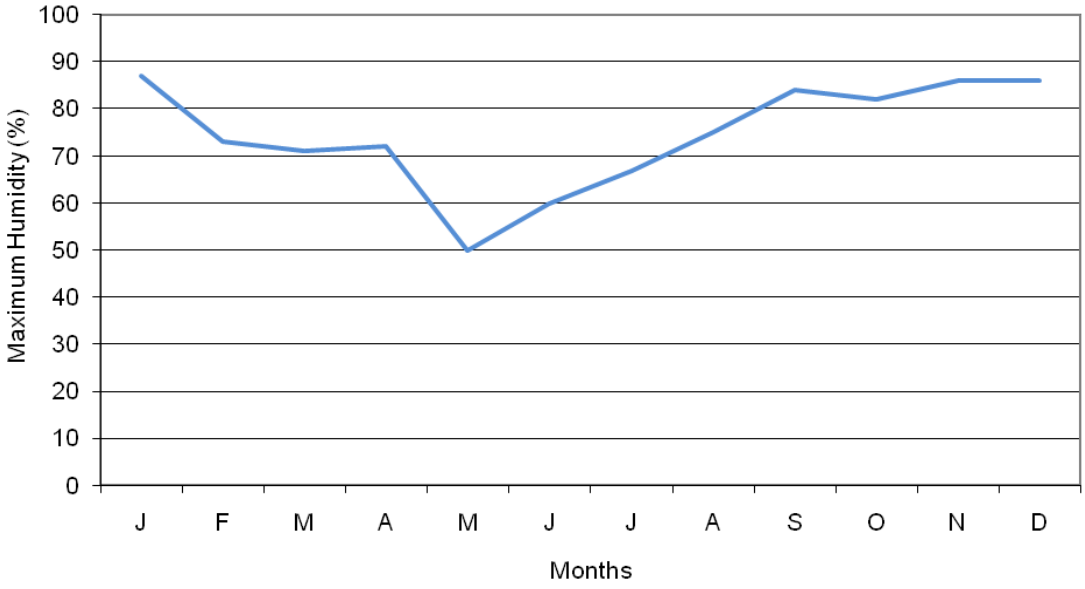

Figure 4-12 Maximum Monthly Humidity, Bahawalpur (2012)

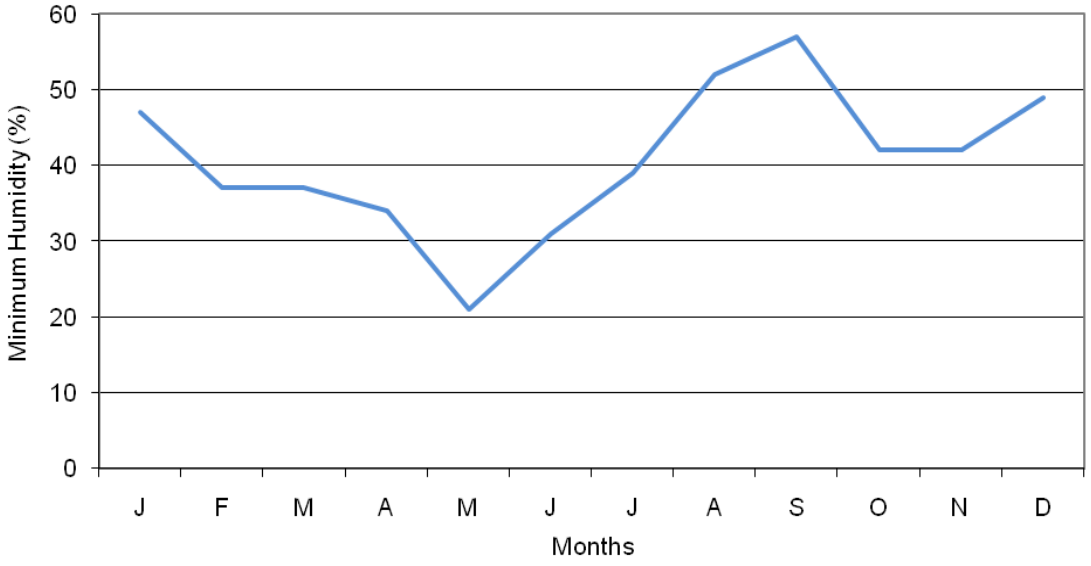

Figure 4-13 Minimum Monthly Humidity, Bahawalpur (2012)

4.2.2.3 Wind

107. Wind velocity is low in winter but begins to intensify during summer and turns into dust storms in May and September periods. Peak values were recorded during the month of June i.e. 4.4 KNOT while the minimum wind speed occurred in the months of December i.e. 0.1 KNOT. The typical wind direction is south to north.

Figure 4-14 Average Monthly Wind Speed, Bahawalpur (2010)

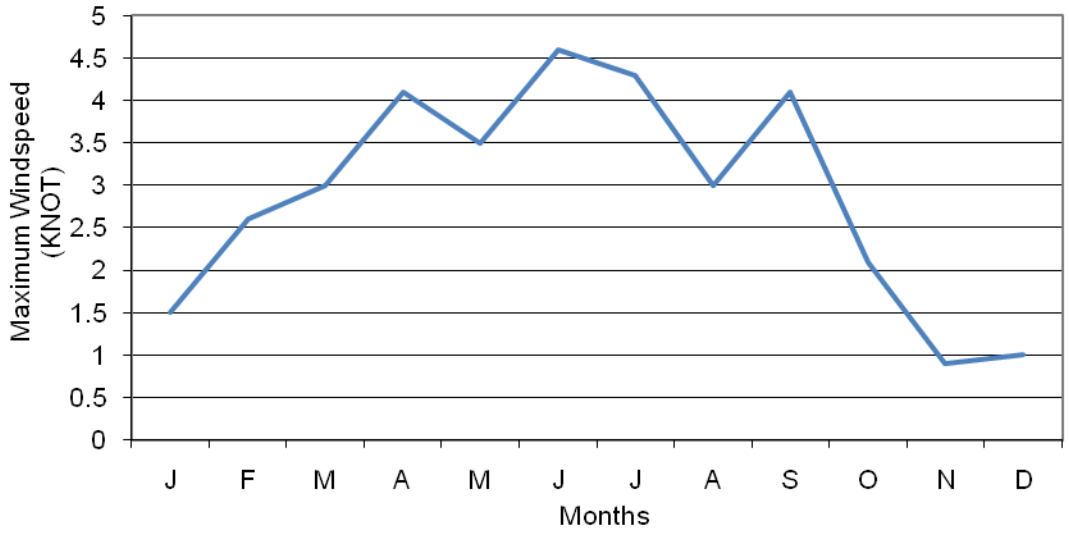

Figure 4-15 Maximum Monthly Wind Speed, Bahawalpur (2010)

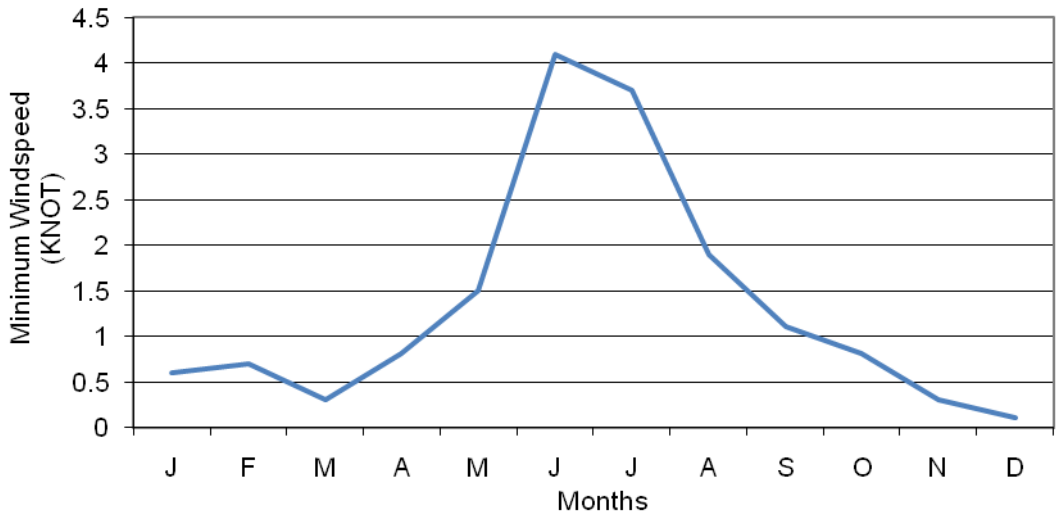

Figure 4-16 Minimum Monthly Wind Speed, Bahawalpur (2010)

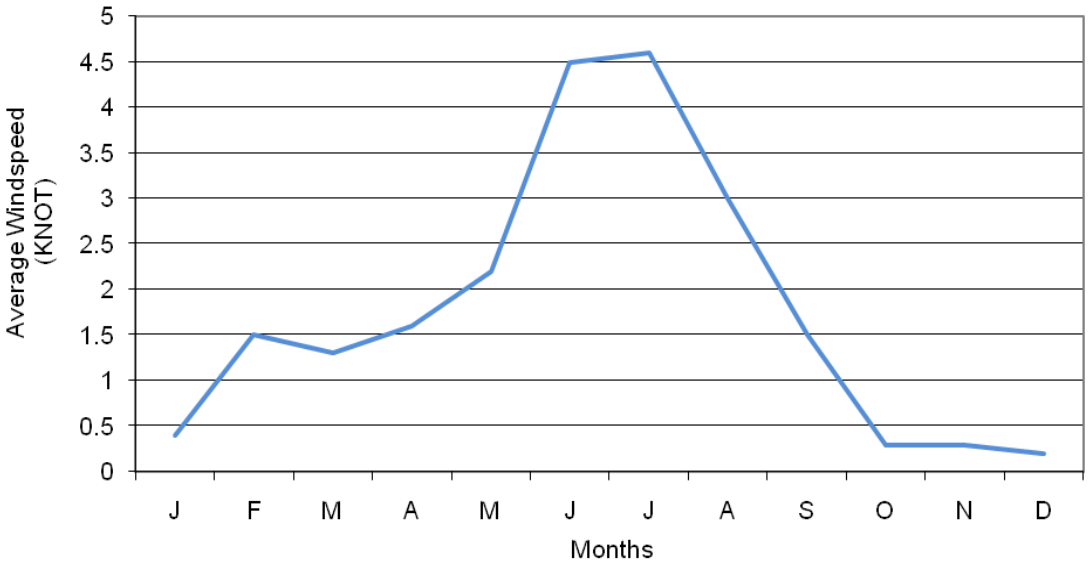

Figure 4-17 Average Monthly Wind Speed, Bahawalpur (2012)

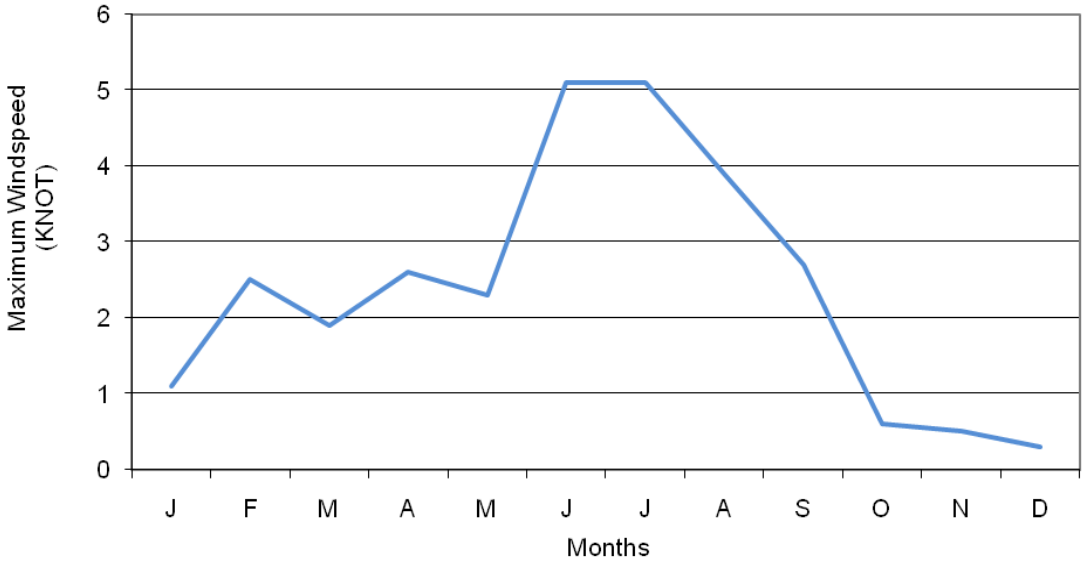

Figure 4-18 Maximum Monthly Wind Speed, Bahawalpur (2012)

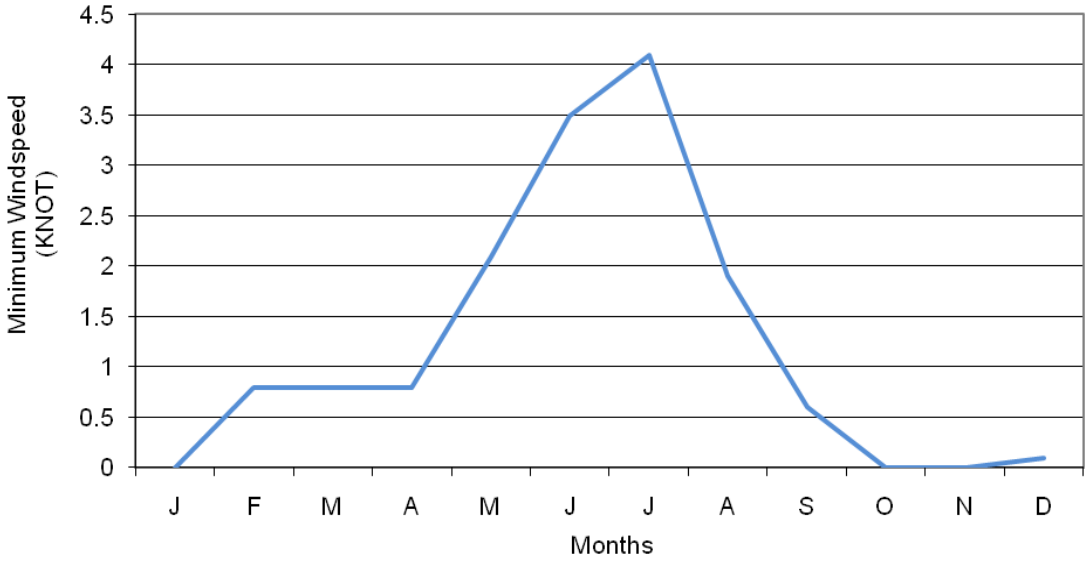

Figure 4-19 Minimum Monthly Wind Speed, Bahawalpur (2012)

4.2.2.4 Climate Change

108. Climate change is considered to be the most imminent global threat. The phenomena refer to variations in planet's global climate or regional climates over time. This change can be caused by natural processes internal to the climate system (e.g. changes in ocean circulation), natural external forces (e.g. changes in the intensity of sunlight) or by human activity that alters the composition of atmosphere or brings about certain changes in land use systems. The increase in average global atmospheric temperatures also referred as "Global Warming" is caused by increases in "greenhouse" gases such as Carbon Dioxide (CO_2), Nitrous Oxide (N_2O), Methane (CH_4), Carbon Monoxide (CO) and Chlorofluorocarbons (CFCs) etc. These greenhouse gases emit from fossil fuel combustion, land use change and industrial processes. The projected levels of global warming have serious consequences for humans (and other life forms). These include a rise of sea levels, which will be caused by a continued melting of ice caps, glaciers and sea ice; major alterations in rainfall patterns; and an escalating in the number and intensity of tropical cyclones. Extreme weather events are also expected to become more frequent.

109. Global weather changes and water resources are deeply inter-related. The largest source of freshwater is rain. Global climatic changes will have major effects on precipitation and runoff. In the relatively arid and semi-arid regions, modest changes in precipitation can have proportionally large impacts on water supplies. In mountainous watersheds, higher temperatures will increase the ratio of rain to snow, accelerate the rate of spring snowmelt, and shorten the overall snowfall season, leading to more rapid, earlier, and greater spring runoff. Climate-induced changes in hydrology will affect the magnitude, frequency, and costs of extreme events, which produce the greatest economic and social costs to humans. Flooding could become more common and extreme. Recent reports of the Intergovernmental Panel on Climate Change (IPCC) suggest that the frequency and severity of droughts could increase in some areas, as a result of a decrease in total rainfall and more frequent dry spells.

110. Any significant change in climate on a global scale may impact local agriculture and therefore affects the world's food supply. Although climate change is an inherently global issue, the impacts will not be felt equally across our planet. Regional changes are likely to differ from global averages in both magnitude and rates of change. Further, not all ecosystems and human settlements are equally sensitive to changes in climate. Nations (and regions within nations) vary in their relative vulnerability to changes in temperature, precipitation and extreme weather events and their ability to cope with such changes. The changing climate is generally deemed the greatest threat to mankind in modern times triggered by the greenhouse gases (primarily produced by the developed nations). This will have profound consequences for water and energy resources, food production and human health etc. in the developing countries like Pakistan. The harmful impacts of global warming are already manifesting themselves around the World in form of extreme weather events like storms, tornadoes, floods and droughts that are mounting in frequency and intensity.

111. Pakistan is low emitter of GHG and contributing only 0.8% towards the total global GHG emissions. The percentage of emissions contributed by each of the GHGs in Pakistan is shown in Table 4-2.

Table 4-2 Percentage Contribution of Green House Gas Emissions in Pakistan

Green House Gases	Percentage
Carbon Dioxide	54
Methane	36
Nitrous Oxide	9
Carbon Monoxide	1
Non-methane volatile organic compounds	0.3

Source: State of Environment Punjab, 2012

112. The following table shows the GHG emissions from various sectors of Pakistan in 1994 and 2008 and projected up to 2050. It reflects that energy and agriculture will remain the major emitters of GHG emissions in Pakistan and national GHG emissions will double in 2020 compared to the year 2008 and increase 14 folds by the year 2050.

Table 4-3 Green House Gases Emissions in Various Sectors of Pakistan

Sectors	Years			
	1994	2008	2020	2050
Energy	86	157	358	2685
Agriculture	71	120	245	1395
Industrial Processes	13	8	26	67
Land use, land use change and forestry	7	9	14	38
Wastes	5	6	7	15
Total National Emissions	182	310	650	4200

Source: State of Environment Punjab, 2012

113. Pakistan is vulnerable to climate change impacts because it lies in the region where the temperature increases are expected to be higher than the global average. It affects the Country in a number of ways as the Indus Basin depends heavily on the glaciers of the western Himalayas, which act as a reservoir, capturing snow and rain, holding the water and releasing into the rivers. As a result of climate change, the entire ecosystem will be affected including river flows, fish stocks, flora and fauna. Three-fourth of the water flowing through the river Indus, Jhelum and Chenab originate in the Siachen and other Himalayas glaciers. Siachen and Pindari Glaciers are retreating at an average rate of 31.5m and 23.5m per year. If these glaciers start melting at a faster pace due to global warming, they could virtually disappear in the next half century. This means increased frequency of floods in the foreseeable future but serious shortage of water in the rivers after some time threatening the livelihood of people dependant on them. The quality of water is constantly deteriorating because of excessive pumping of underground water much of which is saline. Similarly the extraction of sweet water is eroding the centuries old aquifer.

114. Pakistan unfortunately falls in the group of countries highly exposed to negative consequences of climate change. Among the damages already evident in the country is growing frequency of droughts and flooding, increasingly erratic weather behavior, reduction in freshwater supply and changes in agriculture pattern. It has become clear that climate change threatens all progress targets and plans; from health, education to livelihoods, the whole process is endangered by the probability of disasters and uncertain environmental conditions.

115. Better management of water resources is required to cope up the climate change impacts. The water storage capacity is less in Pakistan and the investment is required to increase capacity to store water, in both surface water and groundwater reservoirs. The best preparation for managing unpredictable future changes is to put in place a water resource infrastructure and management system. Pakistan is now starting to explore the combination of ‘hard’ interventions (to protect high-value infrastructure) and ‘soft’ interventions (smart adaptation to living with floods, including changing land use patterns and cropping patterns).

116. The fertile land of Punjab yields more than 50% of the total national agricultural produce due to the efficient use of water resources through Punjab’s irrigation network consisting of 14 barrages. Most of the barrages in Punjab were constructed in the first half of the 20th century. The structural stability of most of these barrages is under threat due to aging and multiple hydraulic /sedimentation /retrogression problems. The designed flood discharge capacities of these barrages have not been increased and vast damages to the public property and life experienced due to frequently occur high floods. Therefore, the Rehabilitation and Upgrading (R&U) of barrages is required to avert any mishap.

117. Panjnad Barrage is situated just below the confluence of River Sutlej and Chenab rivers. Three canals i.e. Panjnad Canal, Abbasia Canal and Abbasia Link Canal with design discharge of 7,769 cusecs, 1,064 cusecs and 5,600 cusecs respectively, off take from left side of the barrage. The barrage provides irrigation supplies to cultivated command area (CCA) of 1.62 million acres (0.66 million ha). The barrage is an old structure and its designed capacity for 100 years return flood has exceeded. As the climate change is going to affect the water resources and the frequency of flood will increase. Therefore, it is required to enhance the barrage capacity by providing an additional structure (gated by pass weir) in order to handle the floods which may increase due to climate change.

4.2.3 Water Quality

4.2.3.1 Surface Water Quality

118. The natural surface water resources of the project area include two rivers Chenab and Sutlej, and three canals namely Abbasia Canal, Panjnad Canal and Abbasia Link Canal offtaking from the left side of the barrage. River Sultej and Chenab have their confluence at about 2km upstream of the barrage. The design discharge capacities of the canals are:

- Panjnad Canal : 7,769 cusecs
- Abbasia Canal : 1,064 cusecs
- Abbasia Link Canal : 5,600 cusecs

119. Sutlej River remains dry during most part of the year due to diversion of its water by India under the Indus Water Treaty (IWT) (1960). Presently, its flows depend upon the water released from the link canals of the Indus Basin System and occasional releases from Ferozepur Barrage in India, usually during monsoon, which are over and above the retention capacities of the Indian reservoirs. On the other hand the flow pattern of River Chenab is more predictable.

4.2.3.2 Hydrological Characterization

120. The average river flows upstream of the Panjnad Barrage are shown in Table 4.4. Average flows were determined for the year 2010, 2009, 2008, 2007 and 2006 during the months between May and October when river flow is significant. This indicates the peak flow usually occurs in August of due to the monsoon season in the area.

Table 4-4 Average River Flows Upstream of the Panjnad Barrage (Cusecs)

Months	Average flow in each year				
	2010	2009	2008	2007	2006
May	10713	12300	6602	31875	30170
June	12050	16683	26719	30864	16148
July	55714	19538	31942	48146	43557
August	177290	32783	49035	41716	162995
September	186465	17036	30631	17742	199700
October	28881	13225	9147	12505	16059

4.2.3.3 Flood Record

121. Panjnad barrage is situated just below the confluence point of river Sutlej and Chenab. River Chenab contributes the major part of discharges at the Panjnad barrage since the rights on Sutlej River were given to India under the Indus Water Treaty 1960. The present barrage capacity is estimated to 700,000 cusec including the annexe weir. The historical record of major floods pass through the barrage is summarized in Table-4.5.

Table 4-5 Very High Floods >450,000 Recorded at Panjnad Barrage

Years	Discharge (Cusecs)
1950	676,722
1955	478,788
1957	529,178
1958	572,670
1959	493,368
1973	802,516
1975	479,754
1976	710,102
1988	507,345
1992	812,152
1995	605,523
1996	571,746
1997	527,163

122. The most recent flood causing the breaching was in 1992 of discharge 812,152 cusecs of which 744,152 cusecs passed through the barrage while 68,000 cusecs through the breaching section. The discharge classification of Panjnad Barrage as given in the Flood Fighting Plan 2010 is given below:

Normal	Below 150,000 cusecs
Low Flood	150,000 to 200,000 cusecs
Medium Flood	200,000 to 300,000 cusecs
High flood	300,000 to 450,000 cusecs
Very High flood	450,000 to 600,000 cusecs
Exceptionally high Flood	600,000 to 750,000 cusecs
Super Floods	750,000 and above cusecs

123. Floods exceeding the designed capacity of barrage are tabulated in Table 4.6.

Table 4-6 Major Floods at Panjnad Barrage Reported by PID

Sr. #	Year	Flow Through Weir (cusec)	Flow Through Breaches in Embankments (cusec)	Total Discharge (cusec)	Category
1	27-09-1950	676,000	NIL	676,000	Exceptionally high
2	16-08-1973	762,516	40,000	802,516	Super
3	12-08-1976	710,102	NIL	710,102	Super
4	18-09-1992	744,000	68,000	812,000	Super

124. During Super floods of 1973 and 1992 breaches took place in left and right marginal bunds. During floods of 1973, idea of providing breaching section at all barrages was listed and implemented after thorough discussions with the experts. Consequently the 1725.5 ft. long breaching section and explosive stores at Panjnad Barrage were constructed on Right Marginal Bund upstream of the barrage during 1976.

4.2.3.4 Surface Water Testing

125. To assess baseline conditions of surface water in the project area, three water samples were obtained on January 2011. The purpose of the surface water testing is to determine the suitability of the water for irrigation purposes as well as for drinking. Abbasia and Abbasia Link canals pass through saline area where local people rely on groundwater for drinking and irrigation purposes. The hand pumps and tube wells have been installed along the canals and people use this water for domestic purposes. Therefore, the maintenance of canal flow is important during project execution. The surface water sampling locations are indicated on Figure 1.3. The samples were collected from River Chenab, River Sutlej and Panjnad Barrage. The contractor is obligated to ensure that in case of an extended canal closure, water of comparable quality must be supplied to the areas directly affected by the closure. Furthermore, during project implementation comparative analysis of water quality at the site will assist in establishing the source of any contamination if present.

126. The samples were collected and tested by an EPA authorized laboratory “GEL”. Standard sampling procedures were followed at each site to ensure the integrity of the samples collected and validity of test results. The details of sampling procedure and test results are included in Appendix 4.2.

Results

127. The test results are summarized in Table 4.7. The water quality parameters were compared against NEQS levels. The NEQ standards have been drafted for the contamination of water quality by heavy metals and other industrial toxins. The NEQ standards are provided in Appendix 2.1.

128. However, since the water that flows towards the barrage and into the canals that off-take from it is primarily used for irrigational purposes, the parameters were compared against the United Nation Organization’s (UNO) Food and Agriculture Organization (FAO) guidelines for irrigation, livestock and poultry in Table 4.8. These guidelines are included in Appendix 4.3.

Table 4-7 Surface Water Quality comparison with NEQ Standards

Sr. #	Parameter	Unit	Results			NEQS (2000) (into Inland Waters)
			Chenab River	Sutlej River	Panjnad Barrage	
01	Odor	TON	0	0	0	-
02	pH	-	7.4	7.3	7.4	6 – 9
03	Turbidity	NTU	42.3	77.1	68.0	-
04	BOD_5	mg/l	2	2	4	80.00
05	COD	mg/l	10	9	15	150.00
06	Total Coli Form	cfu/100 ml	25	15	20	-
07	Total Suspended Solids (TSS)	mg/l	48.0	81.0	78.0	200.00
08	Total Dissolved Solids (TDS)	mg/l	322.0	328.0	336.0	3500.00
09	Chloride (Cl)	mg/l	41.6	42.4	43.5	1000.00
10	Sulphate (SO_4)	mg/l	25.0	24.0	30.0	600.00
11	Nitrates (NO_3)	mg/l	1.0	1.6	1.4	-
12	Fluoride (F)	mg/l	0.28	0.11	0.03	10.00
13	Ammonia	mg/l	0.46	0.49	0.48	40.00
14	Grease & Oil	mg/l				10.00
15	Chromium (Cr)	mg/l	0.01	0.01	0.01	1.00
16	Copper (Cu)	mg/l	0.02	0.04	0.01	1.00
17	Lead (Pb)	mg/l	0.44	0.11	0.21	0.50
18	Mercury (Hg)	mg/l	BDL	BDL	BDL	0.01
19	Selenium (Se)	mg/l	BDL	BDL	BDL	0.50
20	Nickel (Ni)	mg/l	0.01	0.01	0.02	1.00
21	Silver (Ag)	mg/l	BDL	BDL	0.019	1.00
22	Zinc (Zn)	mg/l	0.07	0.09	0.07	5.00
23	Barium (Ba)	mg/l	BDL	BDL	BDL	1.50
24	Iron (Fe)	mg/l	0.02	0.03	0.05	8.00
25	Manganese (Mn)	mg/l	0.122	0.104	0.99	1.50
26	Chlorine	mg/l	0.03	0.07	0.02	1.00

Table 4-8 Surface Water Quality Comparison with Irrigation Standard

Sr. #	Parameter	Unit	Results			FAO
			Chenab River	Sutlej River	Panjnad Barrage	
01	Electrical Conductivity	µS/cm	520.0	530.0	550.0	0 – 3000
02	Total Dissolved Solids (TDS)	mg/l	322.0	328.0	336.0	0 – 2000
03	Chloride (Cl)	mg/l	41.6	42.4	43.5	0 – 1060
04	Sulphate (SO_4)	mg/l	25.0	24.0	30.0	0 – 960
05	Nitrates (NO_3)	mg/l	1.0	1.6	1.4	0 – 10
06	Sodium Absorption Ratio (SAR)	meq/l	1.99	1.53	2.10	0 – 15
07	Magnesium	mg/l	0.122	0.104	0.099	0 – 60
08	Residual Sodium Carbonate	mg/l	61.11	57.78	59.41	-

Analysis of Results

NEQ Standards:

129. The results have been compared with NEQS 2000 as shown in Table 4.7. All water quality parameters tested were within the defined ranges set by NEQS (inland water quality standards).

FAO Guidelines:

130. The water quality testing results were compared with the FAO guidelines for irrigation water as shown in Table 4.8. From the salinity point of view, Sodium Absorption Ratio (SAR) in all three samples of the surface water was detected within the usable range. Laboratory results for Electrical Conductivity also showed that it was within the usable range. Almost all other parameters tested within the defined limits.

4.2.3.5 Groundwater

131. Groundwater depth is as shallow as 5m from the ground level at some places and is mainly used for drinking and agricultural purposes for the local community.

Groundwater Testing

132. To assess baseline conditions of ground water in the project area, one sample was obtained from an existing tubewell at the barrage on January 2011 for analysis. The tubewell was located in the irrigation colony at the barrage. The sampling point is indicated on Figure-1.3. The approximate depth of water extraction of the tube well was 60 feet.

Results of Groundwater Testing

133. The water quality parameters tested for the groundwater sample are summarized in Table 4.9 and Table 4.10. The parameters were compared against NEQS (drinking water standards) and FAO standards.

Table 4-9 Groundwater Quality comparison with NEQ Standards

Sr.#	Parameter	Unit	Groundwater Results	NEQS (2010) (for Drinking Water)
01	Odor	TON	0	-
02	pH	-	7.5	6.5 – 8.5
03	Turbidity	NTU	6.03	<5
04	Cyanide	mg/l	0.001	0.05
05	Chlorine	mg/l	0.04	0.5
06	Total Coli Form	MPN/100 ml	20	0
07	Total Hardness as $CaCO_3$	mg/l	114.4	<500
08	Total Dissolved Solids (TDS)	mg/l	314.0	<1000
09	Chloride (Cl)	mg/l	46.0	250
10	Sulphate (SO_4)	mg/l	20.0	-
11	Nitrates (NO_3)	mg/l	1.7	50
12	Fluoride (F)	mg/l	0.21	1.5
13	Ammonia	mg/l	0.51	-
14	Chromium (Cr)	mg/l	0.05	0.05
15	Copper (Cu)	mg/l	0.02	2.00
16	Lead (Pb)	mg/l	0.17	0.05
17	Mercury (Hg)	mg/l	BDL	0.001
18	Selenium (Se)	mg/l	BDL	0.01
19	Nickel (Ni)	mg/l	BDL	0.02
20	Silver (Ag)	mg/l	BDL	-
21	Zinc (Zn)	mg/l	0.05	5.00
22	Barium (Ba)	mg/l	BDL	0.7
23	Iron (Fe)	mg/l	0.04	-
24	Arsenic (As)	mg/l	BDL	0.05
25	Cadmium (Cd)	mg/l	0.06	0.01
26	Manganese (Mn)	mg/l	0.145	1.50
27	Boron	mg/l	0.6	0.3

Table 4-10 Groundwater Quality Comparison with Irrigation Standard

Sr. #	Parameter	Unit	Groundwater Results	FAO
01	Electrical Conductivity	µS/cm	510.0	0 – 3000
02	Total Dissolved Solids (TDS)	mg/l	314.0	0 – 2000
03	Chloride (Cl)	mg/l	46.0	0 – 1060
04	Sulphate (SO_4)	mg/l	20.0	0 – 960
05	Nitrates (NO_3)	mg/l	1.7	0 – 10
06	Sodium Absorption Ratio (SAR)	meq/l	0.63	0 – 15
07	Magnesium	mg/l	10.7	0 – 60

Analysis of Results

NEQ Standards

134. As shown in above table Lead, Turbidity, Total Coliform, Cadmium and Boron were detected above the permissible limits of NEQS.

FAO Guidelines

135. The water quality test results were also compared against FAO guidelines to determine the groundwater's suitability to be used for irrigation. The analysis of groundwater quality shows that all parameters necessary for irrigation water are within the FAO guidelines.

Groundwater Quality in Canal Command Areas

136. The secondary data for groundwater quality has been collected from the Directorate of Land Reclamation for the canals command areas. The groundwater was classified on the basis of laboratory analysis for Electrical Conductivity (EC), Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) during 2010. For ease in description, the groundwater has been expressed as usable, marginal and hazardous for irrigation as determined by the adverse value of any of the above mentioned three parameters. The classification criteria used is not intended to be strict in relation to the effects of irrigation waters on soil and crop growth and can be truly adjusted according to environmental factors such as climate, type of soil, crops grown and management practices.

137. The samples were analyzed for EC, SAR and RSC. These parameters are used for the classification of water as usable, marginal and hazardous.

	Usable	Marginal	Hazardous
EC x 10^6 µS/cm	0 – 1500	1500 – 3000	> 3000
RSC (meq/l)	0 – 2.5	2.5 – 5.0	> 5.0
SAR (mg/l)	0 – 10	10 – 18	> 18

138. The groundwater quality within the canal command areas are summarized in table 4.11, 4.12, and 4.13.

Table 4-11 Shallow Groundwater Quality (EC) within Canal Command Areas

Command Area of	No. of Water Samples	Electrical Conductivity (EC)					
		Usable		Marginal		Hazardous	
		No.	%	No.	%	No.	%
Panjnad	115	89	77	16	13.9	10	8.7
Abbasia	7	1	14.3	2	28.6	4	57.1
Abbasia Link	49	4	8.2	16	32.7	29	59.2

Source: DLR Report, 2010

Table 4-12 Shallow Groundwater Quality (SAR) within Canal Command Areas

Command Area of	No. of Water Samples	Sodium Adsorption Ratio (SAR)					
		Usable		Marginal		Hazardous	
		No.	%	No.	%	No.	%
Panjnad	115	102	88.7	13	11.3	0	0
Abbasia	7	5	71.4	2	28.6	0	0
Abbasia Link	49	31	63.3	13	26.5	5	10.2

Source: DLR Report, 2010

Table 4-13 Shallow Groundwater Quality (RSC) within Canal Command Areas

Command Area of	No. of Water Samples	Residual Sodium Carbonate (RSC)					
		Usable		Marginal		Hazardous	
		No.	%	No.	%	No.	%
Panjnad	115	108	93.9	6	5.2	1	0.87
Abbasia	7	7	100	0	0	0	0
Abbasia Link	49	47	96	2	4.1	0	0

Source: DLR Report, 2010

4.2.4 Ambient Air and Noise Quality

139. Ambient air quality was monitored over 24 hours at the western side of the barrage on Alipur road near the proposed site for batching plant. Ambient air quality was found reasonably clean as shown in Table 4.14. Noise level was monitored at the eastern and western side of the barrage on Alipur road and the noise level at eastern side of the barrage is detected just above the NEQS level as shown in Table 4.15.

Table 4-14 Ambient Air Quality Monitoring

Sr. #	Parameter	Unit	NEQS (2010)	Results
1	Carbon Mono-Oxide (CO)	ppm	5 (8 hours) 10 (1 hour)	2

2	Sulphur Di-Oxide (SO_2)	$\mu g/m^3$	120	8.1
3	Nitrogen Di-Oxide (NO_2)	$\mu g/m^3$	80	10.3
4	Particulate Matter (PM_{10})	$\mu g/m^3$	150	137.1

Table 4-15 Noise Quality Monitoring

Sr. #	Parameter	Unit	NEQS (2009)	Results
1	Noise on western side	dB	85	84.5
2	Noise on eastern side	dB	85	86.3

4.3 BIOLOGICAL ENVIRONMENT

140. To assess the baseline conditions of biological environment, site visits of technical team, including environmentalists and ecologist, were conducted. The relevant information was also obtained from local community and stakeholder consultation.

141. The existing habitats within the project area include the agricultural land and wetland (including the reservoir, canal system and small water impoundments), of these the agricultural land occupied most of the area. The wetland is an important ecological feature of the site and is a repository to a number of bird's species.

4.3.1 Flora

The Flora can be divided into two parts:

- Riverian Tract
- Adjacent Inland Area

Riverian Tract

142. In riverian tract, especially in pond area the succession of vegetation, first colonizes are grasses and *Typha* followed by *Tamarix* as the soil become consolidated and is raised by the new silt deposition in the scrub, so that the vegetation is no longer completely submerged and erect tree growth becomes possible.

143. As the soil gets stabilized and drained the forest community normally progresses to Acacia nilotica and Dalbergia sissoo. In its present state, the flora of Riverian Alluvial deposits can be listed as follows:

Trees

1. Lai (*Tamarix dioca*)
2. Pilchi (*Tamarix gallica*)
3. Kikar (Acacia nilotica)
4. Shisham (*Dalbergia sissoo*)
5. Beri (*Zizyphus yujuba*)
6. Habd (*Prosopis spicigera)*
7. Mesqette (*Prosopis juliflora*)
8. Mesquette (*Prosopis glandulosa*)

9. Bhen/Poplar (*Populus euphratica*)
10. Khabbal (*Cynodon dactylon*)
11. Kanwal (*Melolotus oralifolia*)
12. Munj (*Erianthus munja*)
13. Kia (*Sacchrum spontaneum*)
14. Kunder (*Typha elephantine*)
15. Date Palm (Phoenix rubicola)

144. Whereas the trees provide a habitat for birds the solid ground below is the houses of mammals. The margin line of Typha and grasses becomes a good habitat for reptiles while the fish occupy the adjacent waters.

Adjacent Inland Area

145. Adjacent area is either on the river banks or on risen parts of the consolidated alluvial deposits within the pond. The natural flora of inland area is as follows:

Trees:

1. Vann *(Salvadora oleoides)*
2. Farash *(Tamarix aphylla)*)
3. Shishm *(Dalbergia sisso)*
4. Kiker *(Acacia nilotica)*
5. Siris *(Albizzia lebbec)*
6. Jand *(Prosopis sicigera)*
7. Beri *(Zizyphus jujube)*
8. Date Palm *(Phoenix rubicola)*

Shrubs:

1. Aik *(Calotropis procera)*
2. Malla *(Zizyphus nummularia)*
3. Karir *(Capparis aphylla)*
4. Peelu *(Salvadora persica),*
5. Phog *(Calligonum polygonoides)*
6. Lani *(Salsola foetida)*

Herbs:

1. Itsit *(Boerhavia diffusa)*
2. Pitpa*pra (Fomaria indica)*
3. Pohli *(Carthamus oxycantha)*
4. Hermal *(Peganum harmala)*
5. Jwahan *(Alhagi maurorum)*
6. Detura *(Datura alba)*

Grasses:

1. Khabal *(Cynodom dacylon)*
2. Dab *(Desmostachya bipinnata)*

Exotics Trees in Adjacent Area

146. Near the banks some exotic tree species have been introduced over the time. Some of these are:

1. Mulberry (*Morus alba*)
2. Bakain (*Melia azadarach*)
3. Shirin/siris (*Albizzia lebeck*)
4. Sufaida (*Eucalyptus camaldulensis*)
5. Ipal ipal (M*inosifolia*)
6. Burr (*Ficus bengalensis*)
7. Pipal (*Ficus religiosa*)
8. Mango (*Mangifera indica*)
9. Jaman (*Eugenia Jambolana*)
10. Toot (*Moris Alba*)
11. Pomegranate (*Punica granatum*)

147. There are total 55 numbers of matured trees (mainly kiker and sufaida) located at junction groyne requiring uprooting for the construction activities, a list included in appendix 7.3.

Economic Ecological Utilization of the Flora

148. The above listed flora consists of trees, shrubs, herbs and grasses. The flora on the whole has following economic and ecological values;

Production Value	Timber, fuel wood and non-timber produce
Protection Values	Soil conservation, wind breaks and protection and habitats for fauna
Environmental Values	Production of oxygen, carbon absorption, cooling of air temperature
Aesthetic Values	Trees as green dimension tool of landscape the other vegetation supplements
Cultural Values	Various produce available out of the flora shape the habits and culture of the adjacent population
Rehabilitation Value	Succession of vegetation on alluvial soil in the river builds up the soil at advance stage this process can add more lands to agriculture use

4.3.2 Terrestrial Fauna

149. The rich Fauna of Chenab River at Panjnad Barrage, upstream in the barrage head pond and downstream in the released waters, is as follows: the data collected from the Wildlife Department.

Mammals

Species	***Scientific Name***	***Status***
Mongoose	*Herpestes edwardsi*	Common
Mongoose	*Herpestes anropunctatous*	Common
Porcupine	*Hystrise indica*	Common
Hedge Hog	*Hemiechinus spp.*	Common
Fox	*Valpes bengalensis*	Less Common
Jackal	*Canis aureus*	Common
Wild Boar	*Sus scrofa*	Common
House Rat	*Rattus rattus*	Common
Squirrel	*Funambulus pennantai*	Common
Hare	*Lepus nigricollis*	Common
Otter	*Lura lutra*	Endangered
Fishing Cat	*Felis vivericula*	Endangered
Jungle Cat	*Felis bengalansis*	Endangered

Reptiles & Amphibian

Species	***Scientific Name***	***Status***
Frogs		Common
Toads		Common
Sand Boa or Du-muhi	*Erys Johnii*	Common
Chequared keel back Snake	*Natrix piscator*	Common
Dark-bellied marsh Snake	*Xenochrophis cerasogaster*	Common
Indian Cobra	*Naja naja*	Common
Indian Monitor Lizard	*Veranus bengalensis*	Common
Variety of lizards, krait and viper		Common

Turtles – Hard shelled

Species	***Scientific Name***	***Status***
Brown River Turtle	*Kachuga smithin*	Common
Saw Back Turtle	*Kachuga tecta*	Common
Brahminy River Turtle	*Hardella thurgi*	Common

Flap Shells

Species	***Scientific Name***	***Status***
Indian Flapshell Turtle	*Lissymes punctata*	Common
Spotted Pond Turtle	*Geochlemys hamiltoni*	Common

True Soft Shells

Species	***Scientific Name***	***Status***
Narrow Headed soft shell turtle	*Chitra indica*	Rare
Indian soft shelled turtle (Sunworshippens)	*Trionysc gangeticus*	Rare
Common Tortois		Common

4.3.3 Birds

150. The barrage pond area provides the habitat of many species of migrating waterfowl and game birds. Partridge is the local protected species of game bird reported in the project area. The list of birds provided below, is prepared during the consultation of Wildlife Department and local community.

Species	***Scientific Name***	***Status***
White breasted kingfisher	*Halcyon smyrnensis*	Common
Red-vented bulbul	*Pyenonotus cafer*	Common
Black drongo	*Dicrurus macrocercus*	Common
Common myna	*Acridotheres tristis*	Common
Bank myna	*Acridotheres ginginianus*	Common
Indian roller	*Coracias benghalensis*	Common
Indian robin	*Saxicoloides fulicata*	Common
Rose-ringed parakeet	*Psittacula krameri*	Common
Black-crowned night heron	*Nycticorax nycticorax*	Common
Blue-rock pigeon	*Columba livia*	Common
Pied kingfisher	*Ceryle rudis*	Common
Little egret	*Egretta garryetta*	Common
Cattle egret	*Bubulcus ibis*	Common
Pond heron	*Areleola grayii*	Common
House crow	*Corvas splendens*	Common
Large pied wagtail	*Motacilla maderaspatensis*	Common
Ring dove	*Streptopelia decaocto*	Common
Little brown dove	*Streptopelia senegalensis*	Common
Asian koel	*Eudynamys scolopacea*	Common
Golden-back woodpecker	*Dinopium javanense*	Common
Yellow-crowned woodpecker	*Dendrocopos mahrattensis*	Common
Barn owl	*Tyto alba*	Common
Spotted owlet	*Athene brama*	Common
Yellow-throated sparrow	*Petronia xanthocollis*	Common
Sind sparrow	*Passer pyrrhonotus*	Common
River tern	*Sterna aurantia*	Common
White tailed plover	Vanellus leucurus	Common
Common sand piper	Actitis hypaleucus	Common
Pheasant tailed Jacana	*Hydrophasianus chirurgus*	Common
Cormorant	Phalacrocoracidae	Common
Gulls	*Laridae*	Common
Lapwing	*Vanellus vanellus*	Common

4.3.4 Migratory Species

The migratory species include:

Species	***Scientific Name***	***Status***
Black Stork	*Ciconia niger*	Rare
Common Shelduck	*Tadorna ladoran*	Rare
Tufted Duck	*Aythy fuligula*	Rare
White Spoon Bill	*Platalea leucorodia*	Rare
Red-crested Pochard	*Netta rufina*	Rare
Common Coot	*Fulica atra*	Common
Common Pochard	*Aythya ferina*	Common
Common Teal	*Anaz crecca*	Common
Mallard	*Anas platyrhynchos*	Common
Pintail	*Anas acuta*	Common
Shoveler	*Anas clypeata*	Common
Gadwal	*Anaz strepera*	Common

4.3.5 Fish

151. The most important types of game fish found in Indus valley are Palla (Tenua losa ilisha) and Mahasheer (Torputitora spp.) which are an exceptional species. But due to construction of a series of barrages Palla cannot migrate from sea upwards and is almost extinct from river waters. Upward breeding movement of Mahasheer is also restricted due to barrages.

152. The data included in this section is collected during the site meeting with the fishing contractors and visit at the local office of Fisheries Department. Mainly the fish is exported to big cities like Lahore, Karachi etc., however small quantity of fish is sold by the vendors along the road near the barrage. Fishing is not allowed within 500m of the barrage upstream and downstream. The contractor(s) can go up to 6 to 7 km from both side of the barrage to catch the fish. Specially designed net (Jal) by the fishermen are the common tool of catching fish. It has been found that more than 90% of the people live around the barrage are connected with the fishing industry during the fishing season.

153. Fisheries play a significant role in Pakistan economy and contribute towards full filling the food requirement of the country. There are also handful numbers of fish shops at the Barrage where both raw and fried fish are sold. The fishing season commence on October and finish by mid of February. During off season local people get involve with agricultural work or temporarily move to the cities to avail money earning opportunities.

154. The list of fishes commonly found at Panjnad Barrage is provided by the fisheries department during consultation and is given below:

Fishes Commonly Found at Panjnad Barrage

Local Name	**Scientific Name**
Gulfam	*Cyprinus carpio*
Khagga	*Rita rita*
Mori	*Cirrhinus marigala*
Mullee	*Wallago attu*
Rohu	*Labeo rohita*
Saul	*Chanra marulius*
Theila	*Catla catla*
Calbans	*Labeo calbaru*
Cereha	*Labeo gonius*
Soony	*Cirrhinus reba*
Kharri	*Barbdes sarana*
Tingra	*Mystus cavasius*
Gonch	*Bagariul bagariul*
Bachwa	*Clupisoma spp.*
Jhalli	*Eutropichthys vacha*
Doler	*Channa punctata*
Pari	*Notopterus notopterus*
Bam	*Mastacembelus armatus*
Shisha	*Chanda baculis*
Kangee	*Colisa fasciata*
Chiddu	*Punctius ticto*
Tilapia	*Orecheronis mossambicus*

155. It can be concluded from the above data that as long as there is no drastic change in the general river ecosystem there can hardly be any impacts on fish population. The overall biological interbalance of the ecosystem is healthy and minor changes do not cross the limits of ecological shock absorbers.

4.4 SOCIO-ECONOMIC CONDITIONS

4.4.1 General

156. A survey was carried out to appraise prevailing socio-economic conditions of the related community in the project areas and to assess the impacts of envisaged rehabilitation and upgrading of Panjnad Barrage on local settlements to cover proposed option of work scheme. To achieve the project objectives, it is imperative to study the prevailing socio-economic and socio cultural aspects of their livelihood.

4.4.2 Study Area

157. Panjnad Barrage is located in Tehsil Alipur (District Muzaffargarh) and Tehsil Ahmedpur East (District Bahawalpur). Muzaffargarh was a small town, about 34 kilometers away from Multan, has been historically identified by a shop, called Musan Hatti, which located on Multan-Dera Ghazi Khan road. The Musan Hatti was named Muzaffargarh after appointment of Muzaffar Khan as governor of Multan in 1794. At the time another town Khangarh about 12 kilometers away from Muzaffargarh, had a status of district headquarters, in 1859, it was replaced by Muzaffargarh as its new district headquarters. The district is situated at the distance of 34 kilometers from Multan across the river Chenab on its east. It is bounded by sub-division Chaubara of district Layyah on its north, district Dera Ghazi Khan on its west and district Bahawalpur and Rahim Yar Khan on its south and south-west respectively. The district is located between 28°-57' to 30°-46', north latitudes and 70°-30' to 71°-47' east longitudes.

158. The name, Bahawalpur, has been derived from Amir Muhammad Bahawai Khan, the eldest son of Amir Sadiq who founded the city of Bahawalpur. It consists of five Sub-Divisions namely Ahmedpur East, Bahawalpur, hasilpur, Khairpur Tamewali and Yazman. The district is bounded on the north by Multan, Lodhran and Vehari districts, on the east by Bahawalnagar district and India, on the south also by India and on the west by Rahimyar Khan and Muzaffargarh districts. The territory of Bahwalpur district lies between the latitude of 27°-48' to 29°- 50' north and between the longitude of 70°-54' to 72°-50' east.

4.4.3 Data Source/Methodology

159. Findings/conclusions of the present socio-economic study of the Project Area based on published data, discussions, meetings with stakeholders, scoping sessions and field survey.

4.4.3.1 Secondary Data

160. Secondary data was collected from various sources as given below:

- District Population Census Report, 1998
- Provincial Population Census Report of Punjab 1998
- Punjab- Pakistan 2008 Mouza Statistics (Settled Areas)
- Punjab Development Statistics, 2011
- Agriculture Census 2000

4.4.3.2 Primary Data

161. All the head of households expected to be affected in the command area of proposed design option were interviewed. Another very important section of the society i.e. gender analysis was also covered in the study. The numerical reality that women constitute about half of the total population of Pakistan ideally assigns to them equal participation role in the economic life of the country. Therefore, all females' counterparts of the Head of Households expected to be affected were also interviewed by female Sociologist.

4.4.3.3 Questionnaire Design

162. Following Questionnaires were designed and administered for the study:

- Questionnaire for Village Profile
- Questionnaire for Households
- Questionnaire for Assets Inventory
- Questionnaire for Gender Analysis

163. All the questionnaires were pre-tested in the field (5th November 2010) and required modifications were made before the initiation of actual survey.

164. A survey team consisting of three experienced Sociologists was constituted (two males & one female). Briefing sessions were held for the survey team members to explain the objectives of the study. Questionnaires were also discussed in detail in the briefing session to ensure that each interviewer understood the meaning of each question.

4.4.4 Culture

165. Concept of culture can provide ways of explaining and understanding human behavior, belief systems, values and ideologies, as well as particular culturally specific personality types. Culture is the full range of learned human behavior patterns. Culture is a powerful human tool for survival, but it is a fragile phenomenon. It is constantly changing and easily lost because it exists only in our minds (Edward B Tyler 1832-1917). In Muzaffargarh district people usually wear Shalwar and Kmeez, Kurta, Waistcoat, Sherwani as dress but in Bahawalpur district the desert women usually wear Ghagra, cotton shirt and Chunni. The dress of Rohi-men is Chaddar and kurta. They wear turban on their heads, while women wear Shalwar and Kameez.

166. The villagers wear Chaddar and Kurta a turban on their heads and place a handkerchief (Rumal) on their shoulders. In the summer season, they like to wear Khussa, Lacha and embroided Kurta. The men in cities also use Shalwar and Kameez. Some of the young men wear trousers and shirt.

4.4.4.1 Settlement Structure Area

167. The information regarding settlements is given in Table 4.16. There are two major types of settlements in rural study area.

Farm Village

168. It is the type where farmers are assembled in a village in the center of the farmland of the mouza/village. They cultivate outlying fields. Table-4.16 reveals that 17 percent, 02 percent, 20 percent, 16 percent and 51 percent villages have one settlement in Tehsil Alipur, Tehsil Ahmedpur, District Muzaffargarh, District Bahwalpur and Punjab province respectively.

Nebulous Farm

169. This is the type where some of the farmers live in a village and till the surrounding fields, while other are scattered beyond the village to live on the isolated farms. Data presented in Table 4.16 shows that 83 percent, 98 percent, 80 percent, 84 percent and 49 percent villages/mouzas comprises more than one settlement in Tehsil Alipur, Tehsil Ahmedpur East, District Mazaffargarh, District Bahawalpur and Punjab province respectively. No village/mouza is unpopulated in Tehsil Alipur, District Muzaffargarh, District Bahwalpur and Punjab Province area.

Table 4-16 Settlement Structure

Area	Total Rural Mouzas	Number of Settlements									
		One		2-3		4-5		6-9		10& Above	
		No.	%	No.	%	No.	%	No.	%	No.	%
Alipur Tehsil	95	16	17	22	23	18	19	29	31	10	10
Ahmedpur East Tehsil	185	03	02	13	07	51	27	42	23	76	41
Muzaffargarh District	926	184	20	189	20	217	23	125	14	211	23
Bahawalpur District	687	113	16	179	26	144	21	82	12	169	25
Punjab Province	23941	12196	51	5855	24	3017	13	1190	05	1683	07

Source: Punjab 2008 Mouza statistics (Settled Areas) Government of Pakistan Statistics Division Agriculture Census Organization.

4.4.4.2 Religion

170. Religion affects human behavior deeply. Religion helps to knit the social values of a society into cohesive whole. It is the ultimate source of social cohesion. The primary requirement of society is the common possession of social values by which individuals control the actions of self and others and through which society is perpetuated. These social values emanate from religious faith. Religion is the foundation upon which these values rest.

171. It is religion that asks man to renounce unsocial activities and requires him to accept limitations upon his wants and desires. All the religions have preached love and non-violence. They have emphasized sacrifice and forbearance. Table 4.17 shows percentage distribution of the total population of the study area by their religions. The study area is predominantly a Muslim society where 99 percent in District Muzaffargarh, 98 percent in District Bahawalpur and 97.70 percent in Punjab Province were registered as Muslims in 1998. Percentage of Christian population is 0.6 percent in District Bahawalpur and 1.9 percent in Punjab Province. Percentage of Qadiani/ Ahmadi population is in few numbers of the all three districts and Punjab Province also.

Table 4-17 Religion (Percent)

Area	Muslim	Christian	Hindu	Qadiani/Ahmadi	Schedule Caste	Others
Muzaffargarh District	99.4	0.3	*	01	*	0.2
Bahawalpur District	98.1	0.6	0.9	0.1	*	0.3
Punjab Province	97.7	1.9	0.1	0.2	*	0.1

*Very small number (not significant)
Source: i) District Census Reports 1998
ii) Provincial Census Report of Punjab Population Census Organization

4.4.4.3 Language

172. Siraiki language is spoken by 100 percent in Study Area. Siraiki is very important language which is very common in study area. Punjabi is second major language in the District Muzaffargarh and District Bahawalpur i.e. 7.4 percent and 28.4 percent. About 4.9 percent, 5.5 percent and 4.5 percent individuals are speaking Urdu in Muzaffargarh District, Bahawalpur District and Punjab Province respectively (See Table 4.18).

Table 4-18 Languages (Percent)

Area	Urdu	Punjabi	Sindhi	Balochi	Pushto	Siraiki	Others
Study Area	-	-	**-**	**-**	**-**	**100**	**-**
Muzaffargarh District	4.9	7.4	0.1	0.1	0.9	86.3	0.3
Bahawalpur District	5.5	28.4	0.1	0.1	0.6	64.3	1.1
Punjab Province	4.5	75.2	0.1	0.7	1.2	17.4	0.9

Source: i) District Census Report
ii) Provincial Census Report of Punjab Population Census Organization

4.4.4.4 Baradri

173. The baradri (brotherhood) is an important aspect of the rural society. Various branches of baradri may not be living in the same locality. Mostly baradries form on the basis of blood relation, caste and occupation. Baradri plays an important role in the farm events e.g. birth, death, marriage etc. in the study area. If a ceremony is done properly it adds prestige to the baradri and enhances the beauty of the occasion. People of the same baradri usually have sympathetic feelings for each other. Vartan Bhaji, a custom in which they exchange gifts on special occasions, is a very common affair of the baradri in the study area. Baradri is a sign of solidarity and unity. It is the evidence of an integrated and pleasant social order relationship. The major caste/baradries are Lashari, Mevery, Chandiay, Sial, Gopang, Qasirni and Mahana in the study area.

4.4.5 Demographic Characteristics

174. The demographic characteristics of study area comprising Alipur Tehsil, Ahmedpur East Tehsil and comparison with the statistics of Muzaffargarh District, Bahawalpur District and Punjab Province are shown in Table 4.19. According to the 1998 census the projected population of the Project Area was 0.08 million inhabitants. The annual population growth rate

of Alipur, Ahmedpur East Tehsils, Muzaffargarh, Bahawalpur Districts and Punjab Province is estimated as 3.24, 2.87, 3.38, 3.08 and 2.64 percent respectively on the basis of intercensal period of 1981-1998. Population is projected by using annual population growth rate of 1981-1998 for Alipur, Ahmedpur East Tehsils, Muzaffargarh, Bahawalpur Districts and Punjab Province as given in Table 4.19.

175. The table indicates that on current population is 6.1 million and 1.0 million in Alipur and Ahmedpur Tehsils respectively. The population density based the projected figure for 2011 is calculated as 467 persons per sq.km in Project Area whereas 436, 611, 496, 146 and 505 persons per sq. km in Alipur, Ahmedpur East Tehsils, Muzaffargarh, Bahawalpur districts and Punjab province respectively. The population density of Ahmedpur East Tehsil is higher as compared to other areas.

176. Household size may also effects the economic situation of the household. Bigger household size may mean more hands to do farm work or non-farm work. It can also mean more mouths to feed. Table 4.19 reveals that the average household size 7.0, 7.4, 6.7, 7.3, 6.8 and 6.9 in study area, Alipur Tehsil, Ahmedpur East Tehsil, Muzaffargarh District, Bahwalpur District, and Punjab province respectively is almost the similar. The relative proportion of two sexes in the total population is an important demographic feature. Sex composition profoundly affects the social and economic behavior of population. It gives the proportion of males to females and is commonly expressed as the number of males per 100 females. The male female ratio in the study area (110:100) is similar in Study Area, Alipur Tehsil, Ahmedpur East Tehsil and Bahawalpur District.

Table 4-19 Demographic Characteristics

Area	Area (Sq. Kms)	Annual Growth Rate (1998)	Population		Population Density (2011)	House-hold Size	Sex Ratio (1998)	Rural Proportion (2011)	Dependency Ratio
			1998	2011					
Alipur Tehsil	1,391	3.24	398,053	6065490	436	7.4	110.2	92.8	106.7
Ahmedpur East Tehsil	1,707	2.87	718,297	1043132	611	6.7	109.8	83.7	97.0
Muzaffargarh District	8,249	3.38	2,635,903	4090330	496	7.3	108.7	87.1	91.0
Bahawalpur District	24,830	3.08	2,433,091	3631197	146	6.8	110.8	72.7	91.0
Punjab Province	205,344	2.64	7,3621,290	103765573	505	6.9	107.0	69.0	87.0
Project Area	181.83	--	56643	84983	467	7.0	110.0	100	104.8

Source: i) District Census Report 1998
ii) Provincial Census Report of Punjab 1998, Population Census Organization

4.4.6 Education

177. A study of educational status not only provides guidelines to policy makers but also help in understanding the demographic behavior of the population (Malik 1967). The literacy level is one of the factors which determine the quality of the human resources. The low percentage of literacy gives the indication of cultural barriers to the spread or innovations and scientific methods.

178. Table 4.20 shows that literacy ratio in Ali Pur Tehsil, Ahmedpur East Tehsil, Muzaffargarh district and Bahawalpur district was about 23 percent, 24 percent, 28 percent and

35 percent respectively. In Punjab Province the ratio was 47 percent with 57 percent male and 35 percent females. However, the literacy rate is low in case of project area as compare to Punjab figures. The district Bahawalpur was ahead than other areas under project coverage in the context of literacy ratio. The number of educational institutions reflects the status of literacy and education level in particular area. There are 5 primary schools for boys, 5 primary schools for girls, 2 middle schools for boys and one middle school for girls in the study area. There are high schools and college are in Alipur and Uch Sharif at the distance of 11 and 14 Km. respectively.

Table 4-20 Literacy Ratio by Sex and Area

Area	Rural			Urban			Overall		
	Both Sexes	Males	Females	Both Sexes	Males	Females	Both Sexes	Males	Females
Alipur Tehsil	19.45	29.64	8.05	65.83	74.88	56.01	23.10	33.15	11.87
Ahmedpur East Tehsil	18.39	27.72	8.05	52.29	60.74	42.72	24.21	33.43	13.94
Muzaffargarh District	24.10	37.00	10.50	55.50	64.80	44.90	28.4	40.10	14.80
Bahawalpur District	26.3	36.4	15.1	57.0	65.3	47.1	35.0	44.9	24.0
Punjab Province	38.0	50.4	24.8	64.5	70.9	57.2	46.6	57.2	35.11

Source: Population Census, 1998 of Muzaffargarh District.
Population Census, 1998 of Bahawalpur District.
Population Census, 1998 of Punjab Province.

4.4.7 Occupation

179. It is useful to have information about occupational distribution of members of the sample households. Such information will facilitate better planning and execution of the project. The rural community in the study area consists of two groups' farmers and those who are landless / non-farm households. Farmers, who own or lease/encroach land, derive their living by cultivating the farm land. This community may also supplement the farms income by raising animals and off farm work. The members of non-farm community generally do agriculture labour, business, services, operating small shops, daily wage work, milk processing and sales and other services to earn the income to fulfill their living necessities. They conduct such business in their own village and nearby villages and in urban areas. About 82 percent, 7 percent and 7 percent of the affected head households of the area are engaged in labor, business and agriculture activities respectively.

180. The data present in table 4.21 indicates the distribution of employed rural population (10 years & above) among various industries/ occupations. About 54 percent, 72 percent and 51 percent of the rural population was involved in agriculture, forestry, hunting and fishing in Muzaffargarh, Bahawalpur and Punjab province respectively. Table also reveals that female participation in agriculture is more in Muzaffargarh and Bahawalpur districts as compare to rest of Punjab.

181. Irrespective to sex, i.e. male and female, Muzaffargarh and Bahawalpur districts were somewhat behind the rest of the Punjab in skilled labor force. A probable reason is the shortage of educational facilities in the technical fields. This further suggests that the area needs specific attention of the government towards not only education but also technical education. This could lead to increased income of the households on the basis of off farm income, an important adjunct as population growth outstrips the returns from farming.

Table 4-21 Employed Rural Population (10 years & above) by Occupation/ Industry (Percentage)

Sr. #	Occupation Group (Industries)	Muzaffargarh			Bahawalpur			Punjab		
		Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female
1	Agriculture, Forestry, Hunting and Fishing	54.41	55.06	40.44	72.55	72.79	56.68	50.75	51.37	32.55
2	Mining and Quarrying	0.15	0.16	0.00	0.29	0.29	0.67	0.37	0.37	0.38
3	Manufacturing	3.07	3.17	0.94	1.01	1.01	1.36	4.19	3.95	10.81
4	Electricity, Gas and Water	0.02	0.02	0.00	0.14	0.14	0.00	0.24	0.24	0.25
5	Construction	24.45	25.47	2.73	12.68	12.80	4.42	25.49	25.82	15.99
6	Wholesale and Retail Trade and Restaurant	5.60	5.84	0.59	4.59	4.63	0.65	4.99	5.06	3.05
7	Transport, Storage and Communication	1.72	1.79	0.23	1.35	1.36	0.69	2.34	2.37	1.50
8	Financing, insurance, Real Estate and Business	0.05	0.05	0.00	0.07	0.04	2.35	0.44	0.45	0.26
9	Community, Social and Personal Services	10.51	8.43	55.07	6.70	6.33	31.88	9.06	8.26	32.38
10	Activities not Adequately Defined	0.02	0.02	0.00	0.62	0.61	1.30	2.13	2.11	2.83
Overall		100	100	100	100	100	100	100	100	100

Source: Population Census Reports, 1998 of Muzaffargarh District.
Population Census Reports, 1998 of Bahawalpur District.
Population Census Reports, 1998 of Punjab Province.

4.4.8 Health

182. The population settle on embankment have no proper access to health facilities in the area and have to travel Alipur and Khairpur Jadid for their treatment at the distance of 11Km and 6 km respectively. All population takes treatment from Doctors. Health condition of the people is generally very poor due to commonly prevalent health issues i.e. malnutrition, due to high rate of child birth, typhoid, cholera and malaria. Blood pressure was a common disease in the study area.

183. Almost 100 percent respondents in the study area get treatment from doctor. Majority 63 percent respondents get treatment from private doctors. They shared their feelings that government medical treatment facility is not satisfactory in the area. According to the Punjab

Development Statistics 2011, there are one hospital, 6 dispensaries, 2 rural health center and 13 basic health units are serving medical facility in the whole Tehsil Alipur under the administrative control of government. But on the other side one hospital, 18 dispensaries, 3 rural health centers and 24 basic health units are available to facilitate the population of the Tehsil Ahmedpur East.

4.4.9 Average Farm Size

184. Sharif et al' (1986) have argued that land is the major determinant of farm income. They have further stated that under the prevailing socio-economic conditions of rural areas in Punjab, control over land has a direct bearing on farmer's ability to earn. The information regarding size of holding and total farms by farm size is given in table 4.22.

185. The data given in table 4.22 reveals that average size of holding is 7.1, 6.1 and 7.2 in Muzaffargarh District, Bahawalpur District and Punjab Province respectively. Total number of farms by farm size categories is also shown in table 4.22. It is evident from the data given in the table that number of farms in small-A category is relatively higher as compare with other farm size categories. The land value ranges from Rs. 500,000 to Rs. 600,000 per acre for various land categories.

Table 4-22 Average farm size and Number of Farms in Each Farm Size Category

Farm Size	Muzaffargarh District		Bahawalpur District		Punjab Province	
	Average Farm size	Total Farms (Percentage)	Average Farm size	Total Farms (Percentage)	Average Farm size	Total Farms (Percentage)
Small-A (Under 5 Acres)	1.73	63	1.85	59	2.08	56
Small-B (5.0 to under 12.5 Acres)	7.48	23	7.57	27	7.59	29
Medium (12.5 Acres to under 25 Acres)	16.51	8	15.47	11	16.26	10
Large-A (25 Acres to under 50 Acres)	30.06	5	29.60	3	30.83	4
Large-B (50.0 Acres and above)	103.29	1	84.12	*	85.72	1
Over All	7.10	100	6.1	100	7.2	100

* Not Significant

Source: Agricultural Census 2000 Punjab

Government of Pakistan
Statistical Division
Agriculture Census Organization Lahore

4.4.10 Drinking Water Facilities

186. The main cause of most of the communicable and abdominal disease is non availability of clean drinking water. Bradley (1976) has dwelt on a number of tropical diseases relating to water supply. About 20-30 different diseases may be caused by water supply for example, viral, bacterial, protozal and helminthic diseases. According to him these diseases may be water borne (infectious) water- bases (due to lack of water) and water related (from insects in water).

187. From the above, it can be concluded that suitable safe drinking water is important factor promoting human health and productivity.

188. During survey it was found that all families had installed hand pumps inside and outside their houses. The proportion of hand pumps for drinking water in the rural areas of district Muzaffargarh, district Bahawalpur and Punjab Province households is estimated as 89 percent, 55 percent and 78 percent respectively inside the houses. Which is also quite high as compared to other sources (Pipe, Well, Pond, etc.) of drinking water. (Table 4.23)

Table 4-23 Source of Drinking Water

Sources	Muzaffargarh District		Bahawalpur District		Punjab Province	
	All Areas	Rural	All Areas	Rural	All Areas	Rural
INSIDE	**93.7**	**93.2**	**80.6**	**75.6**	**86.7**	**83.4**
Pipe (Nul)	6.0	4.6	16.0	7.9	24.3	11
Hand Pump	87.6	88.5	63.5	66.5	60.4	70.6
Well	0.1	0.1	1.1	1.2	2	1.8
OUTSIDE	**6.3**	**6.8**	**19.4**	**24.4**	**13.3**	**16.6**
Pipe (Nul)	0.5	0.4	1.5	1.3	2.2	1.7
Hand Pump	4.8	5.3	8.6	11.0	5.3	7.1
Well	0.1	0.1	2.4	3.1	2.2	3.1
Pond	*	*	3.6	4.9	1.1	1.5
Others	0.9	1.0	3.3	4.1	2.5	3.2

Sources: i) District Census Report 1998
ii Provincial Census Report of Punjab 1998, Population Census Organization Statistic Division, Government of Pakistan

4.4.11 Energy Sources

189. Energy is vital for Socio-economic development. Unluckily, due to isolation living of the scattered population, rural electrification is missing at the Right Marginal Bund (RMB) area of Panjnad Barrage area i.e. 9 households resulting in the alternative use of kerosene oil for lighting. According to District/Province Census 1998, electricity is used by 46 percent, 37 percent and 63 percent households in Muzaffargarh District, Bahawalpur District and Punjab Province rural area respectively.

Table 4-24 Source of Light (Percent)

Sources	Muzaffargarh District		Bahawalpur District		Punjab Province	
	All Areas	Rural	All Areas	Rural	All Areas	Rural
Electricity	51.2	46.0	50.0	37.7	72.5	63.3
Kerosene Oil	47.9	53.1	49.0	61.5	26.6	35.8
Others	0.9	0.9	1.0	0.8	0.9	0.9

Source: i) District Census Report Muzaffargarh District 1998
ii) District Census Report Bahawalpur District 1998
iii) Provincial Census Report of Punjab 1998, Population Census Organization

Statistic Division, Government of Pakistan

4.4.12 Vulnerable Groups

190. No vulnerable groups were identified during the course of surveys as the project has no direct impact on the community/locals located in the project's area of influence. The anticipated indirect impacts originating from the project's activity are insignificant in nature and are mitigable through the implementation of the proposed measures in the proposed environmental management plan (EMP).Gender Issues.

191. Gender problems are critical and are connected to a sustainable development process, which is usually perceived as women specific issues. In order to assess socio-economic impact of running project on women of the project area, all available females counter part of affected families interviewed by female sociologist.

192. Considering the diversity of Pakistani society, female empowerment has different meanings for women from different strata. Her status is always lower than the male partner. She is underprivileged in getting education, food, health care and freedom of choice of partner, number of children and other essentials of life. Like many other legitimate and logical issues, in Pakistan gender issues in general and of men in particular are an untapped area of research and occupy no position in the policy and snatch no place in the planning process.

193. The numerical reality that women constitute about half of the total population of Pakistan ideally assigns to them equal participation role in the economic life of the country and through this approach; we cannot ignore their role in development sector. Therefore survey was conducted by 'Gender Specialist'. Focus group discussions were also held with the women residing along the RMB and LMB of Panjnad Barrage. Ensure representation and presence of women from different socio-economic groups in all meetings.

4.4.12.1 Socio-economic and Cultural Aspects

i) Marital Setup

194. The survey results indicate that 79 percent women get married within their families. The custom of inter family marriages is very common in the project area. Such marriages are as not only a link between man and a woman but it also play role to unite their parents' families.

ii) Women Marriage Age

195. Women age at marriage also contributes a lot in terms of their health (particularly reproductive), education and in the role of development. It is common trend in the study area to marry the daughters at early age especially when they grow up/ reach at working age. Survey results show that majority 58 percent of the women married at the age group of 16 to 18 years, 32 percent at the age group of 19 to 21 years, 5 percent at the age group of 22 to 24 years and next 5 percent at the age group of 25 years and above but not more than 26 years.

iii) Women Role in Decision Making

196. It is observed in the field that women have an insignificant role in decision making. Women are actively participated in farm and non-farm activities but have little contribution in making decision in these areas. About 42 percent women reported their participation in decision making regarding domestic affairs. However, their participation in respect of property matters or in business affairs is about only 10 percent. No nation can rise to the height of glory unless

your women are side by side with you; we are victims of evil customs. It is a crime against humanity that in 21st century women in Pakistan still deprived for their basic rights.

4.4.12.2 Position of Women

197. Women role in development is not a simple one; it relates to a complete range of socio economic activities. Involuntary dislocation may disturb their livelihood. According to the field information it is found that female participation for the betterment of family is more as compared to male. They are working average 11 hours per a day for betterment of their family. In economic side women participate in agriculture activities. They also work as casual hired labor. The field data indicates that 61 percent, 71 percent and 100 percent women participate in agriculture, livestock and domestic activities respectively.

- **Women Participation in Household Tasks**

198. Women also play vital role in maintaining domestic function such as cooking, cleaning the house, washing the clothes & pots and looking after the family. Data indicates that almost 100% women involved in cooking, cleaning pots and in family caring activities.

- **Women Participation in Agriculture Activities**

199. Women of the study area, undertake much of the work in the fields. Results of the data indicate that 61 percent of families involved in agricultural activities. An increase in size of holding is found to have a negative impact on the participation of women in agricultural activities. All 61 percent women participated in various farming operation for crops of wheat, and cotton. These include cotton seed preparation, applying manure, sowing, weeding, hoeing, picking cotton & vegetables and collecting chaff and hey etc. fodder cutting and livestock rearing. In the study area all 61 percent women respondents are working as a casual hired labor for agriculture. Data of district Muzaffargarh and district Bahawalpur regarding employed females present in table 1.6 also support field survey figures. They are working for both season Rabi and Kharif also. It is also observed that wheat and cotton are the major crops of the study area.

- **Women Participation in Livestock Related Tasks**

200. Livestock production is an important and integral component of farming systems in the study area. Livestock also contributes a large proportion of the income of farmers with small-landholdings. About 71 percent respondents (women) participated in livestock relating tasks such as cutting/chopping of fodder, feeding, watering, cleaning the shed, bathing etc.

- **Other Economic Activities**

201. Women participation in economic activities is very low in Pakistan especially in rural areas. Women participation in economic activities will be increased to remove inequities and imbalances in all sectors of socio-economic development and to ensure women's equal access to all development benefits and social services. Women are working as a causal hired labor in project area but their role in other economic activities is very low due to lack of education and vocational skills. The results of the field survey also reveal that about 29 percent women of the affected families have experty in grass mat (suff) making.

- **Existing Women Skills and Needs**

202. The survey data indicates that 100% females show their interest in the education of women, and especially interested in vocational/technical training activities such as sewing, embroidery, knitting, soap making and painting etc. In fact, the activities that they could carry out from the home and so not disturb the male patriarchy.

4.4.12.3 Socio-economic Impact of the Project on Women

203. A strategy has been developed to minimize involuntary dislocation impacts on women. During the survey, the female respondents gave range of positive and negative perception of the project as follow:

- **Positive Impacts of the Project**

204. The rehabilitation and upgrading of Panjnad Barrage has a major positive impact of flood control. Respondents (women) shared their perception regarding new employment opportunities due to the project. Majority of the women in the area work as a causal hired labor as well as attached with grass mat (suff) making economic activity. They show their interest to work as a laborer during construction activities. They accept in increase their household income due to these labor opportunities and it can play the role to raise their living standard. According to them road infrastructure and transport facility might be improved in remote areas due to the project.

- **Negative Impacts of the Project**

205. The adverse impacts on females are related to their day to day activities. Generally, women are responsible for carrying food in the field, wood collection for fuel, and carrying & preparing fodder in the family. Civil works activities could be restricted for female mobility. About 61 percent women of the affected families supplement their income to work as a casual hired labor in agriculture activities and 29 percent participate in other economic activities i.e. grass mat making. And dislocation might be resulted in loss of livelihood. During shifting period, they cannot work as a causal hired labor and in other economic activities, it will not only add to women's economic hardships but for the whole family also. Some women share their feelings that after dislocation their social cohesion within community will be distressed.

4.4.13 Resettlement Issues

206. The social team headed by Resettlement Specialist included female and male Sociologists carried out the project impact assessment. The selected works scheme includes following activities:

I. Modernization and repair works of the barrage

207. The inventory survey reveals that proposed construction of additional depressed bays, modernization and repair works of barrage have no direct adverse impact on community of the project area. It is also found that no archaeological sites and any other structure of cultural importance are.

Figure 4-20 Existing Irrigation Workshop

Figure 4-21 Existing Irrigation Workshop

Figure 4-22 Existing Irrigation Workshop

Figure 4-23 Common Source of Groundwater (Tubewell)

Figure 4-24 Woman Participation in Economic Activities

4.5 BASELINE CONDITIONS OF PROPOSED CONTRACTOR'S FACILITIES AREA

- The proposed sites are government land and private land acquisition will not require.
- No resettlement is required for the establishing of batching plant and labour camp at the proposed sites.
- The proposed sites are barren area and no tree cutting is required for the construction activities.
- The proposed sites have easy access from the existing main road (Panjnad Barrage to Alipur Road) or (Panjnad Barrage to Uch Sharif Road) of the area.
- There are some local depressions in the area which may need to be raised with borrow material.
- The proposed sites are well away (>500m) from the build up area. The sites are within 1km from the barrage.
- No houses are located at the close vicinity at downstream of the wind flow of proposed batching plant.
- Groundwater could be utilized for construction purpose i.e. at batching plant. The test results of collected sample indicate elevated level of heavy metals and not fit for human consumption. Clean source (different tube wells, hand pumps etc) shall be identified for water supply by the contractor or necessary treatment shall be applied before using the groundwater as drinking water.

5. STUDY OF PROJECT ALTERNATIVES

208. The analysis of alternatives for the project is a vital part of the IEE process as it gives the opportunity to review and assess different ways of meeting the project objectives so that the environmental impact of the project is minimal. The following options/alternatives were analyzed for strengths and weaknesses of the proposed project:

- Adding 11 bays on the right side without raising High Flood Level (HFL)
- Provision of bypass gated weir.
- Addition of 4 nos. of depressed bays utilizing the existing junction groyne with increased HFL. The safe barrage capacity is adopted as 700,000 cusecs, as it was achieved in 1992 flood. The additional 165,000 cusecs needs to be bypassed through additional depressed bays at the location of the existing junction groyne and match the barrage capacity to 100 years flood discharge.

5.1 NO PROJECT OPTION (WORST CASE SCENARIO OPTION)

Analysis:

Strength and Opportunities

- There will be no adverse social impacts as no land will be required from private/illegal settlers and for immigrating new settlers.
- The recurring cost of the Project will be avoided.
- The irrigation systems downstream of the canals command area (CCA) of Panjnad Canal, Abbasia Canal and Abbasia Link Canal shall not be interrupted due to project activities
- Loss of the agriculture land which may be required for the borrow area and contractor's facilities (labor camp, batching plants, plant depot etc.), will be avoided.
- The efforts and investments will be saved and will be allocated to another project in case this project is not taken up at all.

Weakness and Threats

- The no project alternative is undesirable as it would mean continued economic, social and environmental losses.
- There will be loss of property and agricultural land due to uncontrolled breaching along the weakened and damaged embankments in the event of a flood.
- The local population shall be denied employment and training during project construction phase and later through escalated economic activities.
- The present leakage through the gates is about 500 cusec and it will also be enhanced with accelerate rate causing water shortage in canal system. Non repairs to canal gates and gearing will also create leakages in canal system and shortages especially in the prevailing rotational programs.
- The aging process along with inadequate/deferred maintenance has contributed to a general deterioration of different components/structures and damages to the regulating gates and hoisting equipment. Any serious damage to this barrage can result in colossal losses in the form of total or partial disruption of irrigation supplies, non/less-production of agricultural crops within the canals command area, loss of government revenue, rehabilitation cost of emergency repairs, thus adversely affecting the national

economy in additional to human sufferings beside multitude of social and environmental hazards.

5.2 ADDITION OF NEW BAYS

Option 1:

209. The following components are included in this option.

- Construct 11 new gate equipment having width of 60 ft.
- Raising/ strengthening of embankments.
- Necessary alteration in the barrage structure associated with the addition of bays i.e. relocation of guide wall(s), canal head regulators, marginal bunds etc.
- Increase the barrage capacity by developing cunnet within the bela and flush the bela during high flow.
- Gate Repair Work.

Strength and Opportunities

- Minimize the requirement of breach at the event of high flood.
- Gates repair work will rectify leakage losses through the damage gates and more water will be available for irrigation purpose in the canals.
- Employment and training opportunities for the local population which will provide them life time benefits.
- Formation of cunnet within the bela will allow the bela to be washed in the event of flood and the barrage will become capable of passing discharge to its maximum capacity.

Weaknesses and Threats

- Adverse social impacts as the existing shops and houses, situated along right side will be required to relocate for the construction of new bays.
- Difficult to construct compare to option 2.
- Thousands of matured trees including mango archord will be uprooted to clear the area for the construction of new bays and relocating the existing structure e.g. canal head regulator, right guide wall etc.
- Construction phase will consist on longer duration and therefore elongated adverse environmental impacts i.e. dust pollution, noise pollution etc. is envisaged.
- Higher environmental management cost, mainly due to the higher environment monitoring cost during the construction phase.

5.3 PROVISION OF BYPASS GATED WEIR

Option 2:

210. The following components are included in this option.

- Bypass gated weir of capacity 165,000 cusecs. The anticipated weir has 11 no. bays of 60 ft. separated by 10 piers of 7 ft. Figure1.3 shows the layout.
- Road Bridge over bypass gated weir.
- Constructing guide banks on the right side of the gated bypass weir structure.

- Constructing leading and spill channels for the gated by pass structure.
- Grouting cavities beneath the barrage floor and Shotcreting of the floors.
- Increase the barrage capacity through partial removal of bela from upstream of the barrage.
- Gate Repair Work.

Strength and Opportunities

- Increase in barrage discharge capacity and strengthening of embankments will minimize the risk of uncontrolled breaching occur at the event of high flood.
- Main town and villages and thousands of agricultural land will be saved from flood damages at the event of high flood by diverting the flood water with bypass gated weir.
- Employment and training opportunities for the local population which will provide them life time benefits.
- Enhance Bio-diversity by undertaking different species of new plantation.
- Gates repair works will rectify leakage losses through the damage gates and more water will be available for irrigation purpose in the canals.
- Improve the existing road conditions.
- Easy to construct.

Weaknesses and Threats

- 10 No. of houses and other infrastructure including a restaurant, shops, graves, shrine, and other structures falling within the work area need to be re-located.
- 855 No. of trees including part of mango orchard found within the area will need to be uprooted.
- Temporary adverse environmental impacts on ambient air quality from construction activities of road bridge and spillway construction i.e. air pollution, dust pollution, noise pollution etc.
- Temporary adverse environmental impacts on wildlife habitat during construction phase.

5.4 ADDITIONAL DEPRESSED BAYS AT EXISTING JUNCTION GROYN WITH RAISED HFL

(SELECTED OPTION FOR DETAIL DESIGN)

Option 3:

211. The following components are included in this option.

- Demolition of the existing junction groyne and construction of 4 depressed bay
- Remodeling of the river training embankments with increased HFL

Strength and Opportunities

- Increase in the barrage discharge capacity and strengthening of embankments will minimize the risk of uncontrolled breaching occur at the event of high flood
- Main town and villages and thousands of agricultural land will be saved from flood damages at the event of high flood
- Life time benefits associated with employment and training opportunities for the local population

- Gates repair works will rectify leakage losses through the damage gates and more water will be available for irrigation purpose in the canals
- Easy to construct in terms of lesser work involved
- No dislocation of infrastructure and other facilities involved
- Low cost involved in terms of managing the environment during project activity

Weaknesses and Threats

- Temporary adverse environmental impacts on ambient air quality from construction activities of the project i.e. air pollution, dust pollution, noise pollution etc.
- Temporary adverse environmental impacts on wildlife habitat during construction phase
- Temporary discomfort to the locals in terms of traffic flow during road closures
- Only 3 No. of houses falling within the work area need to be re-located and resettled
- 55 nos. of matured trees will be uprooted in order to construct the new bays

5.5 CONCLUSION

212. No project option is rejected because the feasibility study conducted in 2012 concludes that the Panjnad Barrage is an unsafe structure. The structural failure of the barrage could cause colossal losses in the form of human life, wildlife, land, property and irrigation set up.

213. Option 1 has been rejected on the basis of technical compatibility as it disturbs the symmetry of the barrage which could encourage shoaling (bela formation) and reduce the barrage capacity.

214. Option 2 has not been selected pertaining to the environmental impacts associated with it in respect of dislocation and resettlement of households and other structures, wildlife habitat destruction and land requirement and acquisition. Moreover, the scope of work associated with this option is wide as compared to the selected one.

215. Option 3 is considered to be the best option as being environmental friendly in nature and technically more viable as compared to the second option. It does not require any resettlement or private land acquisition and has no significant or permanent adverse environmental impacts on the project area. The amount of work required is lesser counter to the case with the second option. It is therefore recommended that Option 3 may be adopted as the optimum solution for managing 100 year flood at Panjnad Barrage.

6. IMPACT ASSESSMENT, MITIGATION AND ENHANCEMENT MEASURES

216. This chapter discusses the potential impacts of barrage rehabilitation and upgrading works which have been identified through the use of standard checklists, and expert knowledge and experience. The impacts identified for the selected option of work scheme were assessed for their significance keeping in mind their consequences, reversibility, occurrence, duration, location, timing etc. The evaluation of the environmental & social impacts has been summarized in Table-6.1.

6.1 POTENTIAL IMPACT SOURCES

217. Environmental impacts and social impacts attributed to the Project can be broadly classified into three main groups.

- Impacts assessment during design phase
- Impacts mitigation during construction phase
- Impacts during operational/post construction phase

218. Some of the impacts can be anticipated and avoided at design stage with appropriate adjustment in the Project Design some can be mitigated by good implementation technique and others by following the operational manual.

6.2 IMPACTS AND MITIGATIION MEASURES ASSOCIATED WITH THE IMPLEMENTATION OF THE PROJECT

219. The following impacts are anticipated in case of the implementation of the Project

- The project will not have any significant adverse impact on the existing residential area other than as a result of increase in noise and dust levels and movement of the additional machinery and traffic
- There will be no major loss or damage to livelihood. The temporary employment to the local communities will be given. This will be a significant positive impact.
- There is no historical monument or archeologically sensitive site hence any apparent impact on such sensitive sites is not expected
- There will be no permanent and significant adverse impacts on the aquatic ecology of the river of the area as seasonal flow regime of the river will remain unchanged. To facilitate the works on the barrage the cofferdams will be built. The environmental impact of cofferdams will be localized and short term (during operation), which can be mitigated with good engineering practice

220. Potential adverse environmental impacts of selected work schemes on the physical, biological and socio-economic environment during design, construction and operational phases have been identified. Measures to mitigate these impacts and their residual impact are discussed below.

(i) Physical Environment

- Land Resources
- Hydrology and Water Resources
- Air Quality

- Noise level

(ii) Biological Environment

- Flora
- Fauna

- Endangered species

(iii) Culture and Heritage

(iv) Socio-Economic

221. The relevant checklist of ADB's Rapid Environmental Assessment (REA) is included in Appendix 6.1. In table 6.1 physical, biological, cultural and social impacts have been discussed under pre-construction (design phase), construction and operational phase. Each sub component has been assessed as slight, moderate or significant. The impacts have then been marked as avoidable, mitigable and irreversible. The components so assessed have been discussed and explained after the assessment of Table 6.1.

Table 6-1 Project Evaluation of Environmental Impacts (Sheet 1 of 3)

Category	Impact Assessment		Impact								
			Slight			Moderate			Significant		
			1*	2**	3***	1*	2**	3***	1*	2**	3***
1. Design Phase											
	1.1	Impacts of Construction Activities				✓					
	1.2	Damage to flood retain embankments				✓					
	1.3	Obstruction to fish migration in the river				✓					
	1.4	Obstruction to gate operations and leakage from the damaged gates				✓					
2. Construction Phase											
Physical Environment	2.1	Impacts of establishing Labour Camp, Batching Plant and equipment & material yard					✓				
Land Resources	2.2	Impacts of Waste Disposal site					✓				
	2.3	Impacts of Borrowing Site					✓				
	2.4	Damage to Paths, Access Roads and Cross Drains					✓				
	2.5	Impacts of Crushed Stone Transportation					✓				
	2.6	Impacts of oil, chemical Spill or Dumping out near Building or House					✓				
	2.7	Damage the agricultural land or crop destruction							✓		
Hydrology and Water Resources	2.8	Impacts of using groundwater as drinking Water & Wastewater disposal Impacts					✓				

* Avoidable through design

** Mitigation through contractor's obligation or by communities through social framework agreement (SFA)

*** Non-reversible, Permanent change (to be adopted)

Table 6.1 Project Evaluation of Environmental Impacts (Sheet 2 of 3)

Category	Impact Assessment		Impact								
			Slight			Moderate			Significant		
			1*	2**	3***	1*	2**	3***	1*	2**	3***
2. Construction Phase											
Physical Environment	2.9	Contamination of Surface water due to construction and dismantling of Cofferdam					✓				
Hydrology and Water Resources	2.10	Contamination of surface water due to Electrical Mechanical Work		✓							
	2.11	Impact of Extended Canal Closure				✓					
	2.12	Impact of Road Bridge Repair					✓				
	2.13	Impact of Additional Depressed Bays construction				✓					
Air Quality	2.14	Impact of Source of Construction Water		✓							
	2.15	Dust Smoke and other Pollutants from Plants & Equipments		✓							
	2.16	Smoke from Burning of Waste material or Burning Firewood		✓							
	2.17	Impact on Air Quality from Earth Work Activities		✓							
Noise	2.18	Noise Pollution from Construction Activities					✓				
*Biological Environmen*t	2.19	Damage to Biological Resources					✓				
	2.20	Disturbance to Wildlife					✓				

* Avoidable through design

** Mitigation through contractor's obligation or by communities through social framework agreement (SFA)

*** Non-reversible, Permanent change (to be adopted)

Table 6.1 Project Evaluation of Environmental Impacts (Sheet 3 of 3)

Category	Impact Assessment		Impact								
			Slight			Moderate			Significant		
			1*	2**	3***	1*	2**	3***	1*	2**	3***
2. Construction Phase											
Socio Economic	2.21	Impacts due to Land Acquisition					✓				
	2.22	HIV/AIDS and other communicable diseases					✓				
	2.23	Impacts on Existing Services; education, health, electricity and water supply etc.					✓				
	2.24	Impacts of finding Archaeological site, Graveyard etc.		✓							
	2.25	Impact on Public Health & Safety due to Construction activities					✓				
	2.26	Impact on Employment		✓							
	2.27	Tribal Tension and local rivalries on canal and aquatic life	✓								
3. Post Construction											
Monitoring and Evaluation as per Operational Manual and Monitoring Plan	3.1	Impacts due to non -application of the prescribed O&M plan							✓		
	3.2	Impacts of raise in HFL					✓				

* Avoidable through design

** Mitigation through contractor's obligation or by communities through social framework agreement (SFA)

*** Non-reversible, Permanent change (to be adopted)

6.3 IMPACTS AND MITIGATION MEASURES DURING DESIGN PHASE

6.3.1 Impacts of Construction Activities

Environmental Impact

222. The construction activities may adversely impact on social, physical and biological environment of the area. The possible social impacts include private land acquisition and involuntary resettlement. Similarly adverse impacts on ambient air, land use and water resources are anticipated during construction activities. Wildlife habitat may be disturbed due to elongated construction activities during construction phase of the project.

Mitigation Measures

- Alternative analysis was carried out (chapter 5) and best suitable option according to environmental point of view was recommended for implementation in order to achieve the derived project objectives.

6.3.2 Damage to Flood Retain Embankments

Adverse Environmental Impacts

223. The aging process along with inadequate / deferred maintenance has been contributed to general deterioration of the structural integrity of the embankments. This could trigger uncontrolled breaches at the event of flood and cause significant damages of the surrounding area.

Mitigation Measures

- Increase the embankments height and width to increase their resistance against floods
- Provide free board (5 ft) for bank strengthening along with berm with vegetation

6.3.3 Fish Migration Obstruction

224. The functioning of the fish ladder is reported to be satisfactory. Hence no substantial remodeling appears to be necessary and there is no obstruction in fish migration.

6.4 IMPACT AND MITIGATION MEASURES DURING CONSTRUCTION PHASE

6.4.1 Physical Environment

(a) Land Resources

6.4.1.1 Impacts of Labor Camp, Batching Plant and Material & Equipment Yard

Environmental Impact:

225. Site preparation activities will cause some temporary changes in landforms. Land surface and top soil will be disturbed in constructing labor camps and other supporting facilities.

226. Because of the availability of the ample PID land near the barrage, there is no need of private land acquisition. PID will arrange the land suggested on figure 1.3 for labour camp and batching plant.

Mitigation Measures:

- The contractor will, in consultation with residence engineer, resolve the exact location of all these facilities.
- PID will arrange the land for the contractor camp and batching plant as indicated on Figures 3.1 and 1.3. It should be preferred that the land selected is a waste land and not an agricultural or crop land to prevent land use change. The contractor will arrange for additional payment to the land owner(s) and approve the new proposed location with consultant's environmentalist and PMO and develop baseline of the site on his own cost.
- The contractor should ensure the restoration of the site to its possible extent.

6.4.1.2 Impacts of Waste Disposal Site

Environmental Impacts:

227. The solid waste generation at the project site would include wrappers and food waste generated at labor camps, construction and demolition waste and special waste; e-waste, oily rags/mops, oil adsorbent pads and containers of hazardous chemicals; lubricants etc. The waste comprising oily rags/mops contaminated with lubes and oil and adsorbent pads originating in result of oil spills is hazardous and its disposal into municipal waste would result in degradation of soil and eventually ground water. Similarly, special waste items including Environmental-waste if disposed along with the municipal waste stream would result in land degradation and eventually groundwater contamination at the disposal site. Construction waste is classified as inert waste which could be a problem to dispose off. Disposing it along with the municipal waste stream will result in alteration of the natural drainage pattern of the disposal site. Inadequate disposal of waste could contaminate the land. Unattended waste and litter in result of improper handling would be a nuisance for nearby communities and will impart poor aesthetics to the surrounding. Domestic waste contains a high percentage of readily degradable hydrocarbons which releases a bad odor when it undergoes decomposition, especially in hot and humid conditions. The waste storage area, if unattended, can attract animals and could be a cause of vector borne diseases.

Mitigation Measures:

- All the waste generated onsite shall be handled and disposed off according to the Waste Management Plan provided in EMP.
- Domestic waste generated at the labor camp and site offices should be collected and temporarily stored at the designated bonded area within the camp area before being disposed off the site by the specialize contractor.
- Dust bins/skips for temporary holding of general domestic waste within the premises of the labor camps should be there and these should be emptied regularly(when filled one third) at the designated storage areas
- The waste should be segregated at source to separate recyclables from it. Color coding can be used to store the waste in separate bins/skips
- A temporary domestic waste storage area should be prepared, maintained and visually inspected on a regular basis by the contractor to prevent the land adjacent to the waste disposal site from contaminating
- The location of waste disposal site should be such that no tree cutting, crop destruction or private land acquisition require

- Construction waste should not be mixed with domestic waste as the construction waste could be reused as a fill material or disposed off separately.
- The temporary waste storage area for domestic waste site will be rehabilitated at the completion of the project and photographic record will be kept as evidence
- The waste shall be collected by the local authorities/waste disposal contractor for disposal at regular basis. It is the contractor's responsibility to arrange collection of waste with local authorities on weekly basis
- 3 Rs (reduce, reuse and recycle) technique may be implemented for proper disposal of solid waste

6.4.1.3 Impacts of Borrow Material Excavation

Environmental Impact:

228. Soil required for strengthening of the embankments will be acquired from borrows areas. The Contractor will get approval for borrow areas from the Engineer's Environmentalist and ESU of PMO before commencing excavation at site. During excavation activity any damage to private land, public or private property will be repaired by the Contractor. The Contractor will also produce an agreement with landowner for the excavation of the borrow area. If the contractor desires to excavate the soil from other areas then approval must be obtained from the Supervision Consultant, and PMO. Quarrying and cutting land is not required in this project.

229. The excavating activities could have adverse environmental impacts including landform change, soil erosion, drainage problem, and impact the health and safety of the workers and local population.

230. Depressions and pits left unfilled after the excavation activity at the borrow area can provide for breeding places for insects like mosquitoes in case of water accumulation or standing water from rain or surface runoff. This will also result in poor aesthetics at the site.

Mitigation Measures:

- If there is lot of transportation involved in using PID land and earth is required to be lifted from privately owned land instead of suggested borrow area the contractor must be obliged to obtain approval from the Consultant's Environmental Specialist and PMO. The private land should be acquired through agreement with the land owner(s) and the owner should be duly compensated by the contractor
- The contractor should not leave unfilled/open depressions and/or pits at the borrow area to prevent water accumulation and problems for the community
- The contractor will ensure that the selected borrow areas are clearly demarcated, and indicate the maximum allowable depth of the pit before the soil is excavated.
- No soil will be excavated outside the demarcated area. If unexpected soil or strata is found during excavation at the site then the excavation must be stopped immediately, and the environmentalist and site manager must be informed as soon as possible.
- The edges of the pits should be given flat slopes and area should be levelled as per satisfaction of the land owner when the excavation is complete. Barren or unfertile land should be preferred for use as borrow area than agricultural land.
- If the agricultural land along the embankments needs to be used as a borrow area then the following additional measurements will be undertaken by the contractor:
  - Excavate at least 50m away from the toe of the embankments

- Remove 6 inches of the topsoil and store on a separate site Reclaimed soil can be used subsequently in site restoration
- Excavate up to maximum of 3 feet
- Level slops as far as possible
- Place the topsoil back on reasonably leveled area.

Residual Impact:

231. Uneven topography will be generated due to excavating land.

6.4.1.4 Damage to Paths, Access Roads and Cross Drains

Environmental Impact:

232. Infrastructure (road, drains etc.) could be damaged through carelessness of the drivers/operators of heavy machinery. Such carelessness can cause considerable damage to paths, road and drains.

Mitigation Measures:

- An effective signage and safety caution board can reinforce the instructions to the drivers for example maximum load limit, type of vehicle allowed, speed limit etc.
- It is a Contractor's contractual obligation to impose strict control over operators and drivers of all type of vehicles
- Licensed drivers should be appointed
- The drivers/operators should be made aware, trained and bound to protect the infrastructure
- The contractor must be bound to carry out the repair, immediately, in case of any damage to access roads or paths due to traffic movement at site
- Maximum speed limit of 30 km/hour should be enforced for site traffic

6.4.1.5 Impacts of Oil/Chemical Spill or Dumping out any Building or House near the Project Area

233. Improper storage, handling and mobilizing of material on site could cause accidental spills or leakages. Dumping of waste material or spillage at the private land or outside the designated area will contaminate the land and water resources as the unconfined aquifer consist on sandy stratum on site.

Mitigation Measures:

- It is a Contractor's Contractual obligation to design, construct and maintain material storage areas.
- All the material mobilization should be controlled and carried out by the competent staff.
- All loading and unloading of the materials should be carried out with an appropriate plant & equipment.
- The material storage area should be bounded.
- Spill kits, including absorbing pad, sand bags etc., should be available at material storage area to handle any accidental spill.
- In case of damage to private land, the land owner(s) should be compensated.
- Secondary containments with 120% volume may be used.
- Shovel and sand may be dumped near the fuel place and AFFF portable fire extinguisher may be placed.

6.4.1.6 Impacts of Crushed Stone and Fine Aggregate Transport

Environmental Impact:

234. Stones shall be brought from Sakhi Sarwar at D.G. Khan, so no quarrying has to be done locally. But the vehicles carrying the stones shall exert additional traffic load on the roads leading to the project area. By keeping the road dust free and repaired even the slightest impact shall stand mitigated. The haulage activity may add to the ambient air quality in terms of dust and noise.

Mitigation Measures:

- It shall be the Contractor's contractual obligation to use the roads and paths carefully and in case of any damage, repair the damaged roads and paths immediately.
- Undertake regular spraying of water on traffic routes and places prone to cause dust pollution.
- Vehicles carrying construction materials should be covered with tarpaulin to prevent material spills and dust generation
- The crushed stone should be transported in safest manner i.e. side wall protection and back side protection to avoid falling of stones on road.
- Reduce journeys to and from the site in order to reduce CO_2 and dust arising from transport/haulage of materials through;
  - Sourcing materials locally, using materials that are locally available reduces haulage costs as well as purchasing from local suppliers can improve the local economy
  - Reducing the number and length of journeys by planning delivery schedules
- Wheel washing facility should be available at sites and the haulage trucks shall first visit the wheel washers before being allowed to enter public roads
- The truck drivers should not be allowed to use blow horns near residential areas and should follow the maximum allowable traffic speed limits as per contract document

6.4.1.7 Impacts of Finding Graveyard and Burials

235. No graveyard is identified within the direct area of influence of the project activities. However if unrecorded graveyards and/or burials are found during the courses of construction activities, the supervising agency will contact and work with local religious authorities within the immediate project area to allow for possible identification of the remains and where appropriate, properly undertake relocation and burial.

6.4.1.8 Contamination from Oil & Diesel and Other Spill from Construction Machinery

236. The dumping site for waste material or empty containers can damage the land with associated physical, biological and social losses.

Mitigation Measures:

- All the oil based material should be stored in the designated bunded area.
- The Spill Kit should be available on site to handle small spills
- Adsorbent pads contaminated with hydrocarbons should be disposed off as per the instructions provided in the MSDS of the product
- Proper handling will minimize accidental spills
- Good housekeeping will prevent land contamination/degradation

- All loading and unloading of fuel tanks as well as fuel transfer should be supervised and carried out as per Contingency Plan.
- Empty drums of the fuel should be handled with care as some material may be left over in the drums or container
- All the liquid material or fuel should be stored well away from any control water body i.e. river, canal, wetland etc.

(b) Hydrology and Water Resources

6.4.1.9 Water Supply System & Wastewater Treatment Impacts

Environmental Impact:

237. Pumping groundwater from the major aquifer for water supply for the labor camp shall neither cause any significant change in the groundwater reservoir, nor in the river or canals, which in fact recharge the reservoir. There will be no any residual adverse impact on groundwater. The impact can be considered as slight and mitigable. The contractor should tap the underground reservoir and install hand pumps or tube wells with an overhead water tank to supply drinking water to the labors and workers at appropriate pressure. Groundwater test results indicate the shallow groundwater quality is not fit for human consumption because of elevated concentration of lead, turbidity, total coliform, cadmium and boron, as shown in table 4.9.

238. It is envisaged that a considerable volume of wastewater will be generated from labor camp. The domestic waste water will be collected at site with the provision of septic tank, any leaks or impaired structure will lead to its seepage into the groundwater and eventually finds its way into the drinking water supply. There are plenty of examples of successful systems of using wastewater for agriculture. Domestic wastewater is expected to be contaminated with pathogens. Many factors affect the degree to which the potential risk due to the presence of pathogen in wastewater can become actual risk of disease transmission and pose a health risk to consumers and workers (farmers). The following situations can have an adverse impact on human health and cause infectious diseases such as cholera, typhoid, diarrhea etc:

1. Either an infective dose of an active pathogen reaches the field or pond or the pathogen multiplies in the field or pond to form an infective dose
2. The infective dose reaches a human host.
3. The host become an infected
4. The infection causes disease or further transmission

Mitigation Measures:

- It is the responsibility of principal contractor to test and confirm the suitability of the groundwater before its supply for domestic use.
- The depth of the extraction well should be increased until the quality of groundwater meets the NEQ standards or the suitable Filtering Unit (depending upon the contamination level) can be installed by the contractor to achieve NEQ standards. Four main measures are recommended to be considered to protect health; wastewater reuse, wastewater treatment, crop restriction, control of wastewater application and exposure, and promotion of hygiene of those wastewater treatment.

- It is the responsibility of the contractor to set up a suitable and appropriate wastewater collection and disposal system. The Contractor will submit the sewerage system design to the engineer. And no any kind of wastewater will be disposed of into river or private land. The sewerage system will be comprises of septic tank and soaking pits with designed filter bed.
- Method and level of treatment of wastewater depends upon the anticipated use of the effluent. In view of the expected use of treated water for agriculture purposes, treatment at primary level will be cost effective. It is therefore proposed that underground septic tank with bypass arrangement for rainwater and soaking pits be provided in the labor camp with about three days storage capacity of waste water.
- To keep the cost to a minimum it is recommended to install a partial wastewater treatment system, using underground septic tanks, as well as crop restriction control measure for reuse of wastewater in agriculture. Treatment by underground septic tank for about 3 to 4 days retention removes most of helminth eggs sufficiently to protect the health of agriculture workers and consumers.
- If the wastewater is discharged into the control water body i.e. river or canal then it is a contractor's contractual obligation to confirm that the effluent meets the NEQS levels. Provision of underground septic tank is a preliminary treatment and reduces the total suspended solids (TSS) concentration to the acceptable level however it may not reduce the BOD level up to the required level. Therefore it is suggested that, if required, an aeration treatment system should be emplaced to meet the BOD level before discharge of the effluent into the river. Aeration of wastewater can be achieved from number of treatment methods including mechanical aeration, providing steps in the open channel, aerobic stabilizing pond (maximum depth up to 4 feet) etc. The selection of treatment method depends on the availability of space and initial concentration of the BOD.
- The treated domestic sewage should be tested on regular basis before it is pumped into the river or used for agricultural purposes.

Residual Impact:

- Treatment of wastewater with the underground septic tank will not cause any odor except during the occasional cleaning of the chambers.

6.4.1.10 Contamination of Surface Water Due to Construction/ Dismantling of Cofferdam

Environmental Impact:

239. During the construction and subsequent removal of coffer dams, the soil material can contaminate river water and affect aquatic life, particularly downstream fisheries.

Mitigation Measures:

- The material used for the construction of cofferdam should not contaminate river water in terms of suspended solids, pH, oil etc. The contractor will use good engineering practices to minimize contamination of river water.

6.4.1.11 Contamination of Surface Water Due to Electrical/Mechanical Works

Environmental Impact:

240. As most of the electrical / mechanical work is to be performed at the barrage structure, any accidental spill of material could be devastating for the river environment. The work also involves building of temporary structures like the cofferdam, scaffolding etc. Failure of the temporary structure could cause serious injuries to the workers and pollute the river.

Mitigation Measures:

- Risk assessment of the area may be carried out and accordingly mitigation measures should be provided. Daily TBT (Tool Box Talk) should be conducted to create awareness among workers and proper supervision needed.
- All temporary structure should be designed and build by a specialized contractor
- The temporary structure should be approved by a competent person before its use
- Daily inspection should be carried out at the work area before the start of every working shift
- Good housekeeping should be maintained to avoid any accidental spill or falling of objects in to the river
- Oil based material should be kept in bunded bowser or container
- Electrical equipment should be handled with extra care
- Provide proper PPE (personal protected equipment) for all the workers as a precaution against any mishap, and interlink various parts of the construction complex
- Ensure proper usage of PPEs by CSC and inform client under the HSE Plan of contractor

6.4.1.12 Impacts of Extended Canal Closure

Environmental Impact:

241. Gate repair work and the installation of the hoisting system and electric motors will require the closure of canals. Non availability of the canal water could adversely affect crops and people living along the canal. The canal water is primarily used for agricultural purposes and at a few places within the canal command area for domestic use.

Mitigation Measures:

- All the activities that require canal closure will only be undertaken during the annual routine closure of the canals.
- If the extended canal closure is required then alternate water supply should be arranged e.g. feeding canals through diversion channels, installing coffer dam to ensure canals supply etc.

6.4.1.13 Impact on Source of Construction Water

242. The contractor could use river water as a source of water for sprinkling on kacha (unpaved) path for dust control and for vehicle washing purposes.

243. Groundwater could be used as a source of water supply for the contractor's camp and the batching Plant. The water should meet the NEQS of Pak –EPA. The contractor should tap

the underground reservoir and install hand pumps or tubewells with overhead tanks to supply drinking water to the labor camp, and to the batching plant for concrete preparation. Withdrawing water from the aquifer shall not cause any significant change in the storage of the aquifer nor the river and canals, which eventually recharge it. The impact can be considered as slight and mitigable.

Mitigation Measures:

- The contractor is obligated under the contract to pay for water obtained from private sources
- The contractor is obligated under the contract to supply running tap water, flush latrines and establishment of underground septic tanks for the disposal of wastewater through the sewerage system.
- All the wastewater generated from vehicle washing and site set ups e.g. batching plant, plant & equipment yard etc. should be tested to meet the NEQ standards for effluents before being disposed off.

(c) Air Quality

6.4.1.14 Dust, Smoke and other Pollutants from Plant & Equipment

Environmental Impact:

244. From previous work experience (rehabilitation of Taunsa Barrage etc.) it has been observed that the dust emission from the batching plant can be very harmful for the site workers and the local population. The dust emission could cause skin and respiratory disease e.g. skin rashes, lungs problem etc. Two batching plants with capacity 30 cm^3/hr (1050 cft/hr) are to be used. The possible suitable location has been proposed for the Batching Plant. Contractor should select the suitable location provided the following control measures are in place:

Mitigation Measures:

- Air quality should be monitored on regular basis near the plant.
- The plant should be located at least 500m away from any living area, as one of the suggested site on Figure 1.3.
- The plant should not be operated outside working hours.
- Regular spraying of water should be carried out to minimize dust pollution.
- All vehicles, machinery, equipment and generators used during construction activities will be kept in good working conditions to minimize exhaust emissions. The fitness certificate may be produced by the Contractor to avoid the emissions. CO and smoke emission test will be carried out on quarterly basis and noise monitoring tests will be carried out three times a day.
- Proper PPE should be issued to the site workers and measures should be adopted to ensure that the workers will wear the PPE properly when working on site.
- If contractor select any other site than the site suggested on figure 1.3 than the site has to be agreed with the consultant's environmentalist and PMO. The following additional control measures may need to be implemented for different location
  - The plant has to be a **Zero Emission Plant** computerized and automatic plant. This will include using washed aggregated and enclosed cylose with automatic injection

system of the material in to the mixing chamber. Recently a zero emission plant has been established and is working successfully at Jinnah Barrage, and could be visited for getting details before installation.

- The plant area should be constructed and maintained on an impermeable layer to prevent contamination of river water from surface run off.
- The access roads for the delivery Lorries pass through the living area. These roads/paths should be sprayed with water on regular basis to minimize dust pollution.

Residual Impacts:

- Deterioration of air quality.
- Although the recommended plant consists of an enclosed cylose, the plant activities will generate some dust especially in consistently dry weather.

6.4.1.15 Smoke from Burning of Waste Material or Firewood

Environmental Impacts

245. A large number of big and small fires in the labor camp can produce smoke which can cut off visibility, reduce traffic ability and cause suffocation along with causing diseases of the respiratory tract.

Mitigation Measures:

- It is the contractor's contractual obligation to use and provide clean and smoke free fuel in the labor camp
- Cutting and burning trees or shrubs for fuel should be prohibited
- Gas Cylinders should be used in the labor camp for cooking purposes

6.4.1.16 Impact on Air Quality of Earth Work Activities

Environmental Impacts

246. Excavating activities will generate dust and pollute the surrounding area. Emissions from the plants used in earth work activities will also degrade the air quality of the site.

Mitigation Measures

- Regular spraying of water should be undertaken to minimize the dust pollution.
- All vehicles, machinery, equipment and generators used during construction activities will be kept in good working condition to minimize the exhaust emissions.

(d) Noise

6.4.1.17 Noise Pollution from Construction Activities

Environmental Impact:

247. It has been proposed to raise the embankment height and width to maintain the stability of the slopes. The embankments farm the boundary of the wetland and trees along the embankments provide habitat of many species of birds. Construction activities along the embankments could generate noise and air pollution and disturb the natural habitat.

Mitigation Measures:

- Suitable equipment and plant should be used in execution of the work to minimize noise pollution
- Noise monitoring will be carried out at strategic locations with the approval of Engineer.
- The noise level should be monitored on a regular basis and levels should be maintained within the NEQS level. At the start of the work activities noise levels should be monitored on hourly basis for at-least the first 2 days of work, after which the monitoring interval could increase to daily basis
- If required, the work area should be cordoned off with noise absorbing panels to segregate the work area from the barrage pond area.
- The contractor will regularly spray water on the site traffic routes to minimize the dust pollution
- All vehicles, machinery, equipment and generators used during construction activities will be kept in good working conditions and will be properly tuned and maintained in order to minimize noise pollution, exhaust emission and minimum land disturbance
- It is the contractor's obligation to stop unnecessary traffic and workers from entering into the barrage pond area
- All working activities should be restricted within the allowed working hours.
- The maximum speed limit of 30km/h should be enforced for vehicles using the embankments and access road
- The Traffic Management Plan will be included in EMP and should be implemented during construction phase
- Movement of the site traffic and tree cutting will generate some noise

6.4.2 Biological Environment

The anticipated biological impacts can be on the following:

- Damage to Flora
- Damage to Fauna
- Damage to Endangered Species
- Damage to Fish

6.4.2.1 Damage to Biological Resources and Disturbance of Wildlife

Environmental Impacts

248. About 5 acres of land will be required for Labor Camp and Batching Plant. The labor camp and batching plant location should be carefully selected with approval of the Engineer to minimize their adverse environmental impacts. The proposed sites for labor camp and batching plant located in state land and no tree cutting will involve for establishing these locations.

249. Clearing vegetation and tree cutting will be required for strengthening the river training works and construction of additional depressed bays.

250. Bela trimming activities could also adversely impact the wildlife habitat of the area during construction phase of the project. However, removal of part of the shoal (bela) will have very little and temporary negative impact upon the existing biodiversity. On the other hand removal of bela will widen the pond area and ultimately increase the carrying capacity for fish. Increased fish will support more fish eating birds and hence the ultimate result of the proposed project will be increased carrying capacity of the site for overall biodiversity

Mitigation Measures

- Carefully select area for labor camp and batching plant so that minimum or no tree cutting is required for these activities. The proposed sites for labor camp and batching plant will not require any tree cutting
- The outside boundary of the camp should be fenced or walled to keep camp activities inside the camp area
- It is the contractor's obligation to ensure that unnecessary and out of bound activities/movements are not done outside the area allotted to him for setting-up the labor camp, material depots and machinery yard
- No fire arms should be carried near any of the site workers
- The outsiders are not allowed to visit the campsite
- All forest, wildlife and fisheries laws should be fully respected and abided by the contractor and his work force
- Limits and norms of wildlife, forestry and fishery should be fully respected and implemented
- Necessary sign boards should be displayed to remind the obligation of labor, visitors and members of public towards Biota
- Inspections by wildlife, forest and fisheries officers are facilitated in camps to facilitate the proper implementation of relevant laws
- 24 hours security should be provided by the contractor at the Labor Camp and Batching Plant
- All vehicles, machinery, equipment and generators used during construction activities will be kept in good working condition and be properly tuned to minimize the adverse impact on waterfowl habitat by reducing noise, exhaust and land disturbance.
- Communities are given awareness and are involved in the proper protection of the Biota inside and around the project area
- No unauthorized tree or bush cutting will be allowed. Should it be necessary, it must not be done without the permission of the "The Engineer" and must follow the change management process
- Walk over survey should be conducted before excavating the bela and any ground nest or particular habitat (rabbit whole etc.) should be relocated
- Excavating work within the bela should not be arranged during the fish breeding season (April to June) to avoid the adverse impact due to a possible increase in the turbidity of the river

6.4.3 Socio-Economic Impacts

251. The overall impacts of the Project on the social and economic activities in the project area will be positive. The adverse environmental impacts and their mitigation measures are discussed as follow:

6.4.3.1 Impacts of Land Acquisition

Environmental Impacts:

252. Generally land acquisition is required for work activities such as widening or constructing new embankments, access road, labor camp, batching plant, work base area, structural waste disposal site and contractors camp. To facilitate these activities Punjab

Irrigation Department is already in possession of enough land where these works can be executed. Proposed locations for labor camp and batching plant site would also be accommodated in the Irrigation Department land.

Mitigation Measures:

- All the activities requiring land acquisition are to be planned by PID. No private land acquisition is anticipated for project implementation. However if private land is to be acquired than the 1894 Land Acquisition Act shall be follow and the cost of the land is to be paid to the owners. An appropriate framework agreement should be completed and signed by all the concerned parties and submitted to the Engineer

6.4.3.2 Social Impacts on Local Population due to Migrating Labor from other Parts of the Country

Environmental Impacts:

253. There is a risk of adversely affecting the social life of the local population due to the arrival of a large number of laborers from outside the area. Extra burden on the local infrastructure and services e.g. medical facility, shops, restaurants, mosque, public transport etc. is also anticipated.

Mitigation Measure:

- The outside boundary of the camp should be fenced or walled and 8 – 10 guards will be deputed on shift duty for security reasons.
- Locating a labor camp at least 500m or ideally 1km away from the villages (local settlement).
- Leisure facilities including play grounds, restaurant etc. should be provided inside the labor camp.
- All the unskilled labor and where possible skilled labor should be arranged locally. As per contract document, minimum 50% local labor will be recruited
- Pick and drop facilities should be arranged for local labor.

6.4.3.3 HIV/AIDS and other Communicable Diseases

254. The Labor Camp, their interaction with truck drivers and like personnel are potential places for the spread of HIV/AIDS if the incidence exists. Majority of the people living in the surrounding of the Project, and potential Labor are not aware of the source, mode of communication or consequences of HIV/AIDS. Although their religious and cultural value system, to a large extent excludes the outbreak or rapid communication of HIV/AIDS, yet its occurrence in such a situation cannot be precluded. It is necessary that along with other communicable diseases like Cholera, Typhoid, Diarrhea and Tuberculosis, awareness and preventive campaigns are run from time to time in the Labor campus and the field offices of the Project on Communicable diseases. Training on HIV/AIDs will be provided by an approved trainer.

Mitigating Measures:

255. The Contractor shall;

- Arrange to run a proper campaign, in the labor camp, to make people aware of the cause, mode of transmission and consequences of HIV/AIDS. Training on HIV/AIDS will be provided by an approved trainer.
- Strengthen the existing local health & medical services for the benefit of the laborers as well as the surrounding villages.
- Ensure proper cleanliness and hygienic conditions at labor camp by ensuring a clean mess, proper drainage and suitable disposal of solid waste. Inoculation against Cholera will be arranged at intervals recommended by Health Department.
- Keep all the camps, offices, material depots, machinery yards and work site open for the inspection of health and safety measures, and related documents.
- The contractor will conduct the medical test of all labor prior to induction.
- The heating and cooling facilities will be provided by the Contractor. The free medical facilities will be paid by the Contractor in case of injury.
- Pick and drop facilities from labor camp to workplace will be provided by the Contractor.

6.4.3.4 Existing Services & Employment (Positive Social Impacts)

256. The economic analysis shows high economic benefits compared to costs. Salient economic benefits of the project are:

- Improvement of available services in the area and opportunities for employment, education, healthcare, transportation, especially for women and children.
- Easy marketing of agricultural products.
- Availability of jobs during construction phase shall employ and train a large number of unemployed youth. They will receive a life time of benefits through skill training, capacity building and poverty alleviation. A large number of semi-skilled and unskilled workers in the project area will be hired.
- Greater awareness about Healthcare including HIV/AIDS and Hepatitis amongst the laborers and the local community shall be created.
- At micro level, economic activities may bring the cost of living down by making essential commodities available in greater bulk and at cheaper rates. This combined with better employment opportunities will bring poverty line rate lower.
- The developing new public park will raise the aesthetic value of the area and will attract tourism. Rehabilitation of the barrage structure will also have a positive impact on the local tourism industry.
- Boost to agriculture through ensured and enhanced irrigation water.
- Increased economic activity with improved irrigation.

6.5 OPERATIONAL AND MANAGEMENT (O&M) PHASE

6.5.1 Impacts of Non-Application of the Prescribed O&M plan

257. Rehabilitation & Upgrading of Panjnad Barrage will not make any alteration in the Barrage operation process and therefore no adverse impact is anticipated to induce due to the implementation of the project. At operational phase of the proposed Project a comprehensive Operation and Management (O&M) Manual shall be prepared by the Project Manager at the completion of the work as per ISO (International Organization for Standardization) Standards. An effective monitoring and evaluation has to be done as per O&M and monitoring plan.

Mistakes at operational level or handling the operations by untrained staff can prove very risky and costly. Important points to be attended at the operational stage are as follows:

(i) Develop comprehensive O&M Rules
(ii) Strict implementation of prescribed Environmental Management Plan (EMP).
(iii) Continuous evaluation of design efficiencies
(iv) Understanding and training of staff on Operation and Maintenance Manual
(v) Annual Environmental Audit
(vi) Regular maintenance of engineering works
(vii) Continued public consultation and feedback on it
(viii) Continued attention towards gender issues and women consultation
(ix) Irrigation system to run up to its design capacity and not beyond
(x) Refresher Training Courses for operational staff.

258. On the basis of the impact assessment, the project will improve environmental and social condition of the area. No permanent adverse environmental impacts have been identified due to the project implementation. All the adverse impacts resulting from the construction activities are mitigable.

6.5.2 Impacts of Raising HFL

259. Under the selected project option, the river training works will be remodeled to cope with increased HFL at the event of super flood. It is envisaged that the additional area will be inundated within the barrage pond area at the event of super flood for 2 to 3 days. This may cause damage to houses and infrastructure located within the pond area. However the impact is negligible compare to the possible impacts due to breach in embankments at the event of super flood i.e. losses of thousands of acres of crop, damage infrastructure etc.

- It is recommended that losses of the settlers living in the pond area shall be calculated at the end of every super flood and compensation shall be given to the affectees according to the state law.

- Flood warnings and its possible impacts shall be communicated properly well before the flood arrival with the settlers located in the pond area.

Possible site for the disposal of construction waste along LMB at 1 RD to fill the low line area

Fish Ladder Located along the divide wall

Proposed site for Labor Camp

7. ENVIRONMENTAL MANAGEMENT PLAN

260. This chapter comprises a detailed Environmental Management Plan (EMP) for the project. The EMP proposes an effective plan of action that will indicate responsibilities and required measures to minimize the negative environmental & social impacts at various stages of the project. It is the responsibility of the Contractor to develop Site Specific Environmental Management Plan (SSEMP) and get approval from Construction Supervision Consultants (CSC) before the commencement of the physical works on site.

The Environmental Management Plan for the Project has been discussed under three main components:

- Mitigation Plan
- Monitoring Programme
- Institutional Arrangements

261. Most of the mitigation activities planned in the EMP will be executed & covered under provisions in the construction contract and with necessary agreement with the communities.

7.1 MITIGATION PLAN

262. The mitigation plan is a key component of EMP. The mitigation plan includes measures to mitigate potential negative impacts and enhance its positive impacts during initial physical works and normal operation of Irrigation System. This section outlines the potential impact of rehabilitation works on the physical, biological and socioeconomic environment and their associated mitigation measures. It also assigns the responsibilities for implementing these measures.

- Lists of mitigation measures which will be directly covered by the consultant's environmentalist and contractors and not those mitigation measures which are covered under civil or mechanical work.
- The person(s) responsible for ensuring the implementation of the measures.
- The person(s) responsible for the monitoring.
- Parameters to be monitored for the effective implementation of measures.
- A time scale for the implementation of measures to ensure that the objective of mitigation plan is fully met.

263. The Mitigation and Monitoring Plan for the activities likely to have a direct impact on the environment is presented in EMP table.

7.2 MITIGATION OF IMPACTS AT DESIGN PHASE

264. Majority of negative impacts can be avoided (eliminated) through the use of adequate and environmentally sound technical design. The Project has however been designed on the basis of the lessons learnt from similar projects and major design initiatives undertaken to avoid any major negative impacts are as follows:

1. Necessary measures should be taken to exclude any big deposits of soil or debris anywhere.

2. To ensure the availability of water at the tail ends of canals off take from Panjnad Barrage.
3. As far as possible appropriate indigenous technology and knowledge should be utilized while planning and designing the project.
4. Improve flood fighting plan by strengthening embankments, provision of bypass gated weir and Barrage structure.

7.3 MITIGATION OF IMPACTS AT CONSTRUCTION PHASE

265. To reduce the potential impacts of the construction activities there will be a monitoring programme to assess contractor's compliance/performance with the project EMP during construction phase.

266. The contract document will contain requirements for:

(i) Proper management of construction waste.
(ii) Control measures for waste fuel disposal.
(iii) Reduction of oil/lubricants, spill or leakage, noise and dust level.
(iv) Rehabilitation of areas used for construction detours and sites used for temporarily storage of construction materials.
(v) Proper use and maintenance of equipment with appropriate noise and smoke abatement.
(vi) Restoration of borrow areas (whether on state land or private land).
(vii) Other requirements as obligation of the contractor emanating from the EMP.
(vii) Specific provisions will also be included to make it mandatory to use formal health and safety measures including protection against Communicable diseases and Hepatitis. Group insurance measures to minimize accidents and avoiding fatalities during the construction process.
(viii) Advisory element to address a number of other issues will also be included in the contract. These will include:

- Road Closure

267. For transporting construction material or conveying heavy machinery to the site, the rural roads passing near or through village(s) may have to be closed temporarily and access of public for certain period may have to be blocked. The dates, timings and duration of such period will need to be agreed with authorities and communities.

- Cultural and Historical Resources

268. Communities shall be requested to identify in the field, all known sites of cultural and historical value that may be affected by the Project, for protective actions by the contractor.

- Archaeological Field Support

269. The Government of the Punjab will make available (on demand) a qualified archaeologist to conduct field investigations when important search work and new material sites area opened. No such site is yet in view but just in case it does, the services of archaeologist will be obtained.

- Graveyard and Burials

270. If unrecorded graveyards and/or burials are found during the courses of construction activities, the supervising agency will contact and work with local religious authorities within the immediate Project area to allow for possible identification of the remains and where appropriate, properly undertake relocation and burial.

- Local Employment

271. The contractor will be advised to arrange locals as unskilled labour and skilled workers are easily available from local communities as and when required. It is desirable that maximum employment benefits are made available to local communities.

- Land Acquisition and other Compensations

272. During the community consultation, in the Project area, it was made clear by the communities that they would expect due compensation, if their buildings, trees or land were affected or destroyed during construction activities or any of its allied structures. Social Action Plan has been prepared to address the social impacts of the Project.

- Resource use Agreement – Construction Materials

273. Earth is commonly available in abundance around the Barrage area. Stones are available from Sakhi Sarwar. Yet there may be a need for additional agreement with public to obtain certain materials. In that case the farmland should be given the last priority in procuring the fill material when inevitable, however, due compensation should be paid. Whenever the borrow pits are dug, considerable care should be taken in their location. The site may invariably be rehabilitated after use. Ideal situation would be that the site is made good to a condition similar to that prior to the project. It will be helpful if photographs of pre-project condition are used for the purpose of comparison.

- Resource Use Agreements – Water

274. Although ample quantity of groundwater is available in the Project area, yet the contractor will be required to confirm the quality and demand detail and indicate source of water prior to the start of construction. Disposal plan for wastewater without polluting the fertile soil, river water or ambient air, shall be produced by the contractor for approval of The Engineer/Project Director.

7.4 MONITORING PLAN

275. Monitoring Plan is an essential component of the Environment Management Plan (EMP). Implementation of the EMP shall be the contractual obligation of the Contractor. For that the Contractor shall engage full time technical staff capable of carrying out the suggested measures in the EMP as contractual obligations under the contract agreement. The construction supervision consultant (CSC) shall also have a full time Environmental specialist and Environmental Inspector to provide an overall professional cover to the environmental monitoring process and the procedures and initiate required reports and point out any gaps in the implementation of the mitigation measures or enforcement of the measures of the EMP. Environmental & Social unit (ESU) under PMO will be responsible of the overall implementation of EMP and provide technical guidance to the construction supervision consultants and Contractors.

Environmental Mitigation & Monitoring Plan

BC- Before Construction; DC- During Construction; AC- After Construction; CEnv- Contractor's Environmentalist
PMU/PMO Project Management Unit/ Project Management Office; CSCEnv- Construction Supervision Consultants Environmentalist

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
A- LAND RESOURCES								
1	**Borrow Materials from Earth Borrowing Site**	**Borrow Material:** Soil excavation from the designated area of the site will be required for strengthening of the embankments and construction of coffer dams. Construction of bypass gated weir will generate soil material which could be used as fill material provided it meets the engineering parameters. Contractor has to get approval of the borrow from Consultant's Environmental Specialist and ESU of PMO before commence excavation on site.	1.1 Ensure that selected borrow areas are clearly demarcated with barricading/fence before starting any soil excavation and no soil removal is undertaken outside the demarcated area.	CEnv	CSCEnv PMO-ESU	Records of clear boundary marker demarked in place	BC Once before start of excavation	BOQ
			1.2 Ensure that Photographs are taken of the area before and after the restoration of the borrowing site.	CEnv	CSCEnv PMO-ESU	Photographs records	BC, DC, AC	BOQ
			1.3 Ensure that the excavation for fill material is restricted to specified depth.	CEnv	CSCEnv PMO-ESU	Compliances with Specification	DC Check once a week on typical working day	SFA

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		Excavation and earth movement activities may generate dust and affect the air quality of the surrounding area. Material to be used for the construction of the coffer dams will include silt for core filling, soil material for random filling.	1.4 Ensure that the surface drainage is provided to control the surface run off.	CEnv	CSCEnv PMO-ESU	Control in place. Their effectiveness in case of rain	BC, DC Once before construction Once a week on a typical working day	BOQ
			1.5 Ensure that the movement of earth moving machinery is limited to the work area.	CEnv	CSCEnv PMO-ESU	Compliance Site inspections	DC: Daily Once a month	BOQ
			1.6 Ensure that erosion protection measures are taken, such as retaining wall (if required), avoidance of steep cut.	CEnv	CSCEnv PMO-ESU	Visible signs of any soil erosion	DC Monthly basis Once after rain	BOQ
			1.7Barren and infertile land should be preferred for use as borrow area. If agricultural land is used as borrow area then the land will be	CEnv	CSCEnv PMO-ESU	A detailed protocol in checklist	DC, AC Daily At completion of excavation When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			restored by the contractor and follow the following steps: • Remove first 15cm top soil and keep it on site to re-spread after completion of the excavation. • Excavation of the earth fill should be limited to an approximate depth of 90cm. • Stabilized the slope during the excavation.					
			1.8 Ensure that the borrow area is levelled and the edges of the pits are given flat slopes as far as possible and as per the satisfaction of	CEnv	CSCEnv PMO-ESU	Photographs record	DC, AC When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			the land owner and top soil restored after the completion of the excavation activity					
			1.9 Ensure that complete documentation for the borrow areas is maintained i.e. volume excavated, date of excavation, levelling date after completion of excavation	CEnv	CSCEnv PMO-ESU	Records	BC, DC At the start of the excavation.	BOQ
			1.10 Ensure that regular water sprinkling is carried out during executing of excavation to mitigate the dust pollution	CEnv	CSCEnv PMO-ESU	Compliance	DC Daily When required	BOQ
2	**Construction of new Access Road and Widening of**	New roads will not require providing the access to the contractor's facilities i.e.	2.1 Contractor will furnish the traffic management plan, according to the	CEnv	CSCEnv PMO-ESU	Compliance with specification	BC, DC When required	Direct Cost

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
	Existing Roads	batching plant, material yard, labour camp etc. Access road may require for the approach to the boat bridge. There is ample PID land available on site and private land acquisition will not require for the access roads. The general mobility of local community their livestock as well as their business activities and clientele in and around the construction area may be hindered.	recommendations made in IEE and must be implemented in order to control the traffic.					
			2.2 It is the contractor's contractual obligation to provide training to drivers and operators. The driving license will also be submitted to the Engineer for approval	CEnv	CSCEnv PMO-ESU	Compliance with specification	BC	Direct Cost
			2.3 Ensure that the temporary route(s) are adequate for the existing traffic plus the site traffic.	CEnv	CSCEnv PMO-ESU	Compliance	BC, DC Daily When required	BOQ
			2.4 Ensure that water sprinkling is carried out at regular basis to prevent dust pollution.	CEnv	CSCEnv PMO-ESU	System in place	DC When required	BOQ
			2.5 Ensure that the traffic sign board	CEnv	CSCEnv PMO-ESU	Compliance Photographs	DC Daily	Direct Cost

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			regarding revised road layout and change in speed limit or new speed breakers are placed at least one Km from the alteration.				When required	
			2.6 Ensure that the alternative route is designed on the basis of the traffic survey conducted by the contractor (if require).	CEnv	CSCEnv PMO-ESU	Compliance	BC Once at start of the allied work	Direct Cost
			2.7 Ensure that mobility of the men and animal is not hindered due to the construction activity.	CEnv	CSCEnv PMO-ESU	Compliance Social Survey	DC Daily When required	BOQ
			2.8 Any damage to the land, property or existing roads from the contractor's activities will be remediated by the contractor at the	CEnv	CSCEnv PMO-ESU	Record Photographs	DC Once at the start of the work When required	SIA

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			earliest possibility.					
3	**Site for Disposal of Construction Waste Material**	It has generally been observed that at completion of construction the waste material is dumped at the site without proper planning. The material from the coffer dams will be in significant quantity and will require proper disposal site.	3.1 Ensure that the selected disposal site is marked and fenced before starting the work.	CEnv	CSCEnv PMO-ESU	Record	BC	BOQ
			3.2 Ensure that Photographic record of the waste disposal site is kept before starting waste disposal activity and after site restoration	CEnv	CSCEnv PMO-ESU	Photographs record	BC, DC Once before start When required	BOQ
			3.3 Ensure that all trucks used for the transportation of waste construction material are covered and watertight	CEnv	CSCEnv PMO-ESU	System in Place	BC, DC Once at the start of work When required	BOQ
			3.4 Ensure contractor's obligations define in contract document are followed	CEnv	CSCEnv PMO-ESU	Compliance	DC Daily	BOQ
			3.5 Ensure that the	CEnv	CSCEnv	System in Place	DC	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			movement of lifting machinery and vehicles is limited to the disposal site		PMO-ESU		Daily When required	
			3.6 Ensure that waste material is properly disposed off, compacted and cover in a manner that does not affect the natural drainage	CEnv	CSCEnv PMO-ESU	Compliance	DC Daily After every rain fall When required	BOQ
			3.7 Ensure dumping and levelling on site only as agreed per contract agreement and SFA (in case private land used).	CEnv	CSCEnv PMO-ESU	Follow Contract Documents and complete SFA	DC Daily When required	BOQ
4	**Installation of Batching Plant**	**Land requirement:** Ample land is available near barrage to establish batching plant. **Land contamination:** Dumping of waste fresh concrete may	4.1 Ensure that no private land is used to establish the batching plant. Contractor needs to get approval from CSCEnv and PMO-ESU if he/she uses any private land	CEnv	CSCEnv PMO-ESU	Compliance	BC Once at the time of installation of Batching Plant	SFA

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		contaminate the land. **Raw material:** Raw material for the construction work mainly include cement, sand, aggregate, steel, water lubricants, fuel and additives. The material will be stock piled at the area provided by PID near the batching plant. **Wind direction:** While installing the batching plant the direction of the wind should be consider.	for this purpose. Contractor will pay for the use of private land					
			4.2 Ensure that the location of the batching plant is at least 500 m away from the villages (main settlement) and should be oriented out of phase with the prevailing wind direction. If the selected location is within 500m from the residential area then it has to be a zero emission plant	CEnv	CSCEnv PMO-ESU	Compliance with specification	BC Once before installation of Batching Plant	SFA
			4.3 Ensure that land contamination from the batching plant, during transportation and dumping of the wasted fresh concrete is controlled through	CEnv	CSCEnv PMO-ESU	System in place	DC Daily When required	SFA

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			careful working of the Contractor's crews to avoid spillage of concrete and dumping of waste concrete on private land. Carry fresh concrete in mobile concrete drums.					
			4.4 If the selected location is next to the control water body i.e. Sutlej and Chenab River or active canal then the area for batching plant should be bunded with an impermeable layer to stop contamination of the river or canal water from the surface run off in case of rain or otherwise. The area should be maintained on regular	CEnv	CSCEnv PMO-ESU	Design and prepare the Batching Plant area by a competent person. Photographs record	BC At the stage of establishing batching plant DC Weekly inspection When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			basis.					
			4.5 Ensure that leak / spill record is maintained for each incident of spill or damaged vehicles. Damaged/defected vehicles will not be operated unless repaired.	CEnv	CSCEnv PMO-ESU	Compliance	DC Daily When required	BOQ
			4.6 Ensure that the material is stocked piled at the designated area provided by PID near the construction site.	CEnv	CSCEnv PMO-ESU	Compliance with specification	BC/DC At the time of establishment of Batching Plant	BOQ
			4.7 Ensure that surface drainage is not blocked due to the pilling of the raw material.	CEnv	CSCEnv PMO-ESU	System in place	DC Daily Once a month after each rain.	BOQ
			4.8 Contractor will store material on site with care and suggestions provided	CEnv	CSCEnv PMO-ESU	System in place	DC Daily	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			in IEE in order to minimize the risk of spill or leakage into the river or control water body					
			4.9 Contractor will store the admixture properly and walkways will also be constructed inside the camp area.	CEnv	CSCEnv PMO-ESU	Compliance	BC Once at the time of installation of Batching Plant.	BOQ
5	**Contractor's Camp Location and Workshop**	**Land requirement:** There is ample PID land available around the project area for the contractor's camp, officer hostel, work shop etc. So no private land will be acquired for the construction of these facilities. PID will arrange land for the labour camp construction and batching plant.	5.1 Ensure that no private land is used to construct the contractor camp and workshop(s)	CEnv	CSCEnv PMO-ESU	Compliance	BC Once at the Time of camp establishment	BOQ
			5.2 Ensure that the location of the labour camp will be at a distance of 500m from the major local settlement.	CEnv	CSCEnv PMO-ESU	Measured distance	BC Once before the establishment of the camp.	BOQ
			5.3 PID will provide space near the	CEnv	CSCEnv PMO-ESU	Compliance	BC Once before	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		Disposal of waste water: The unmanaged disposal of wastewater, generated from labour camp & vehicle washing area, will contaminate land. The contractor can use the existing disposal system (for offices and official residence) after making necessary renovation / expansion of the system only to a limited extent. However the existing disposal system cannot cope with the wastewater generated from labour camp. **Utilities:** Contractor will share the facilities of water supply, telephone lines and electricity on	barrage to establish contractor's camp and workshop.				the establishment of the camp	
			5.4 Ensure that Photographs of area adjacent to the camp site and other features are taken prior to commencement of any work activity which should be used as a reference during site restoration	CEnv	CSCEnv PMO-ESU	Photograph records	BC: Once before construction activity	BOQ
			5.5 Ensure that room size(s) are as per standard specifications	CEnv	CSCEnv PMO-ESU	Compliance per specification	BC: During camp design phase	BOQ
			5.6 Ensure that domestic washing areas are demarcated and water from washing areas and kitchen is released in filter bed soaking pits.	CEnv	CSCEnv PMO-ESU	System in places	DC Daily When required	BOQ
			5.7 Ensure that septic	CEnv	CSCEnv	System in	BC, DC	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		payment basis with PID **Disposal of solid waste:** Unmanaged disposal of solid waste will contaminate land, spread bad odor and cause unhygienic conditions at the work place. Existing disposal arrangement can be used after making necessary renovation / expansion of the system by the contractor.	tank of appropriate design are used for sewage treatment and outlets released into sumps, further treatment system or used for agriculture.		PMO-ESU	places	Once before start of work When required	
			5.8 Ensure that latrines, septic tanks, and soaking pits or sumps are built at a safe distance from water hole (tube wells or hand pumps), stream, or dry streambed and the bottom of the sump or soaking pits is above the ground water level	CEnv	CSCEnv PMO-ESU	Compliance	BC During design phase of camp set up and waste treatment system	BOQ
			5.9 Ensure that sumps are located: • In absorbent soil • Downslope and away from the camp • Downstream from	CEnv	CSCEnv PMO-ESU	Compliance per specification	BC Once at the Time of camp establishment	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			the camp water source and above the high watermark of any nearby water body (if any).					
			5.10 Ensure that effective drainage system is in place at site.	CEnv	CSCEnv PMO-ESU	System in place	BC Once at the start of work	BOQ
			5.11 Ensure that existing wastewater disposal system is not overstressed, if used.	CEnv	CSCEnv PMO-ESU	System analysis On-going consultation with local authorities	DC Monthly basis	BOQ
			5.12 Ensure that Contractor makes assessment and carries out renovation / expansion works of existing facilities in consultation with PID. PID shall assist the contractor in this regard.	CEnv	CSCEnv PMO-ESU	System in place	DC When required	Direct Cost

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			5.13 Ensure the implementation of Solid Waste Management Plan, as described in section 7.9 of the IEE • Material suitable for recycling should be collected separately in three bin system and sold • Combustible waste burnt at burn pit only • Non- combustible, non recyclable garbage sent to the designated waste disposal pit site in an area. • Medical waste transported to any hospital incineration plant • Solid residue from the septic tank will	CEnv	CSCEnv CSCEnv PMO-ESU	Implementation of Waste Disposal Plan	BC, DC Once before establishing Contractor's Camp Daily during Construction Phase When required	BOQ Direct Cost

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			be transported to municipal sewage facilities at the nearest place • Contaminated soil sent to burn pit or landfill.					
6	**Relocation of Camps, Material Storage Area, Batching Plant and Special Approaches Routes and Roads**	**Land requirement:** The recommended locations for batching plant, labour camp site and contractor's camp are approachable through provincial roads. Therefore no private land will require for access roads.	6.1 If relocations happened, contractor obligations defined as per Contract documents and SFA agreement shall apply	CEnv	CSCEnv PMO-ESU	Compliance with SFA	BC When required	SFA
			6.2 If the contractor selects different location for the batching plant, labour camp etc. from the recommended locations then the contractor will develop base line data for the new location on his own cost, resources and get approval from	CEnv	CSCEnv PMO-ESU	Compliance	BC At the set up of the Batching Plant, Labour Camp etc.	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			the CSCEnv and PMO.					
7	**Access Tracks**	**Damage to paths roads and linear fixtures crossed/damaged by moving machinery moving to and from the construction site:** Heavy traffic may damage the existing roads or private property. Contractor will carry out necessary repair work.	7.1 Ensure that Contractor remain vigilant about the moving machinery should remain within the boundary of PID land	CEnv	CSCEnv PMO-ESU	Compliance with map Site inspections	DC Daily Once a month	
			7.2 After completion of construction work all the damaged roads will be restored by the contractor, as it is involved in contractor's obligations.	CEnv	CSCEnv PMO-ESU	Compliance	AC When required	BOQ
			7.3 Ensure that gravel is dumped only on locations allowed by the Consultants and dumping of gravel does not result in blocking of traffic, damaging vegetation	CEnv	CSCEnv PMO-ESU	Compliance to civil drawing Site Inspections	DC Once at the start of work On monthly basis	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			or cause any drainage problem.					
			7.4 Ensure that construction corridors along the access road are marked.	CEnv	CSCEnv PMO-ESU	Compliance	DC Daily Monthly basis	BOQ
			7.5 Ensure that the access roads do not block the natural drainage and culverts.	CEnv	CSCEnv PMO-ESU	Control in place	DC Once at the start of work	BOQ
			7.6 Ensure that surface run-off controls are installed and maintained so as to minimize soil erosion and ponding of area with rain water.	CEnv	CSCEnv PMO-ESU	Control in place	DC Once after every rain storm	BOQ
			7.7 Ensure adherence to the speed limit of 40 km/hr at the access roads.	CEnv	CSCEnv PMO-ESU	Compliance	DC When required	BOQ
			7.8 Ensure that construction corridor is monitored and	CEnv	CSCEnv PMO-ESU	System in Place	DC Daily When	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			repairs are undertaken when required.				required	
			7.9 Ensure that vegetation clearing will be minimized and no tree will uprooted without prior permission of consultant.	CEnv	CSCEnv PMO-ESU	Compliance with IEE/EMP	DC When required Once a month	BOQ
			7.10 Ensure that the disposal of cleared vegetation is not in a manner that may affect the blockage of natural drainage.	CEnv	CSCEnv PMO-ESU	Site Inspections Implementation of Waste Disposal Plan	DC Daily Once a month	BOQ
8	**Waste Disposal Management**	This component describes the waste disposal plan that will be employed during the construction and restoration period. The main types of waste to be disposed off will be; Fuel, oils, and	8.1 Ensure that the selected construction waste disposal site is demarked before starting the work.	CEnv	CSCEnv PMO-ESU	Compliance	BC/DC When required	BOQ
			8.2 Ensure that Photographs of the area of the nominated waste disposal site	CEnv	CSCEnv PMO-ESU	Photographs record	BC/DC Once at the start of work When	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		chemicals (from empty drums, contaminated soil etc.), sewage, campsite waste, medical waste, demolition waste, packaging waste and excess construction material.	are collected to restore the site at the completion of the construction phase.				required Once a month	
			8.3 Ensure that all the waste generated from different locations must be disposed off according to the Waste Disposal Plan.	CEnv	CSCEnv PMO-ESU	System in Place	DC As and When required	BOQ Direct Cost
			8.4 Ensure that all trucks used for the transportation of waste construction material must be covered and watertight.	CEnv	CSCEnv PMO-ESU	System in Place	DC When required	BOQ
			8.5 It is the contractor's contractual obligation to complete and follow the SFA in case of any private land damaged/ contaminated due to	CEnv	CSCEnv PMO-ESU	SFA Environmental Audit	DC Once a week When required	SFA

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			disposal of waste generated from the construction activities					
			8.6 Ensure that the movement of lifting machinery and vehicles is limited to the work area.	CEnv	CSCEnv PMO-ESU	Compliance	DC Daily When required	BOQ
			8.7 Ensure that soils are properly disposed off in a manner that does not affect the natural drainage	CEnv	CSCEnv PMO-ESU	Site Inspections	DC As and When required	BOQ
9	**Land Contamination due to Spill of Lubricants, Fuel, Chemicals and Other Waste Material**	The construction machinery includes cranes, trucks, loaders/ dumpers and batching plants (to be used during the construction period). There are chances of contaminating of the land due to release of contaminated effluents, accidental spill, leaks,	9.1 Ensure that the maintenance of vehicle (LTV and HTV) and other plant takes place only in designated areas underlined with concrete slabs and a system to catch surface runoff. The contractor will construct lined wash	CEnv	CSCEnv PMO-ESU	Compliance System in place	DC Daily As and When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		run off from the material storage yard etc.	area for vehicle washing.					
			9.2 Ensure effluents from rig washing and other potentially contaminated effluents are released in to soaking pits	CEnv	CSCEnv PMO-ESU	System in place	DC When required	BOQ
			9.3 Ensure that fuels, oils, and other hazardous substances are handled and stored according to standard safety practices such as secondary containment bunded area. Fuel tanks should be labelled accordingly.	CEnv	CSCEnv PMO-ESU	System in Place	DC Once in week When required	BOQ
			9.4 Ensure that fuels, oils, and chemical are stored in areas lined	CEnv	CSCEnv PMO-ESU	System in place	DC Once every 15-days	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			by an impermeable base and containing dykes. The Material Safety Data Sheets (MSDS) will be available at fuel storage area				Once a month	
			9.5 Ensure spills are avoided during fuel and oil transfer operations. Appropriate arrangements, such as to minimize carrying around at site should be made. If required, carry in proper container(s) or vehicles	CEnv	CSCEnv PMO-ESU	System in place Arrangements in place	DC Daily When required	BOQ
			9.6 Keep spillage kit including shovels, plastic bags, absorbent materials and sand bags on site near fuel and oil	CEnv	CSCEnv PMO-ESU	System in place	DC Daily Once a month	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			storage areas					
			9.7 Ensure that refuelling of vehicles is planned on daily basis to minimize travel and chances of spill.	CEnv	CSCEnv PMO-ESU	Work Planning	DC Daily	BOQ
			9.8 Ensure that operating vehicles are checked for any fuel, oil, or battery fluid leakage regularly.	CEnv	CSCEnv PMO-ESU	Compliance	DC Daily When required	BOQ
			9.9 Ensure that incidents of leak / spill record are maintained for each vehicle and repairs affected vehicles at the earliest opportunity. Leaking vehicles will not be operated unless repaired.	CEnv	CSCEnv PMO-ESU	System in place Maintain Record	DC Daily When required	BOQ
			9.10 Soil contaminated by minor spill (covering	CEnv	CSCEnv PMO-ESU	Compliance	DC When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			an area up to 0.1 m² and 75 mm deep) will be collected and disposed off at burn pit.					
			9.11 Ensure that soil contaminated by moderate spills or leaks (up to 200 liters) is contained using shovels, sand and soil. The contaminated soil will be removed from the site and sent to waste disposal pit site or burn pit as required. Major spills of volume exceeding 200 liters will be handled and controlled by a specialized contractor as suggested in Waste Disposal Plan.	CEnv	CSCEnv PMO-ESU	Compliance	DC When required Once a month	BOQ
10	**Agricultural Land**	It is envisage that no	10.1 Ensure that	CEnv	CSCEnv	Implementation	DC	SFA

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
	and Crop Destruction	agricultural land is involved for the establishing of the contractor's facilities i.e. batching plant, labour camp, contractor's camp, material yard, workshop etc. Accidental damage to the crop or agricultural land may happen due to mistake of contractor's vehicle driver or labour.	destruction of agricultural land is avoided by controlling the work activities and vehicles movement by the trained banksman.		PMO-ESU	of Contractor's contractual obligation	Daily When required	
			10.2 If it is absolutely unavoidable and private land or crop damage from the contractor's activities takes place then the affectees will be compensated and SFA completed by the contractor.	CEnv	CSCEnv PMO-ESU	Compliance SFA	DC When required	SFA
11	**Any Discharge or Diversion of Water to a Graveyard or Archaeological Site**	No graveyard / archaeological site are found in the project area so no such situation may occur in the area.	11.1 If during construction such sites are found and discharge or diversion of water likely to damage the site then it is the contractor's obligation not to let it happen.	CEnv	CSCEnv PMO-ESU	Site Inspections	DC Daily When required	Direct Cost

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			11.2 Solve the problem by collaboration with the communities as per SFA.	CEnv	CSCEnv PMO-ESU	Compliance SFA	DC When required	SFA
12	**Electrical & Mechanical Works**	Renovation of electrical and mechanical installations of the existing barrage will be carried out in situ so there will be no impact on the land resources due to this activity.	No action is required					
13	**Extended Canal Closure**	The construction activities require canal closure will be scheduled in such a way that these must be finished within normal canal closure period and avoided extended canal closure. If require construct cofferdam or temporary structure to maintain routine	13.1. Ensure that the extended canal closure is avoided by planning the work activities.	CEnv	CSCEnv PMO-ESU	Compliance of Work Plan	DC When required Once a month	BOQ
			13.2 In case of emergency avoid full closure of canal by setting up cofferdam.	CEnv	CSCEnv PMO-ESU	Compliance	DC When required	Direct Cost
			13.3 Cofferdams or temporary diverted routes of canals will	CEnv	CSCEnv PMO-ESU	Site Inspections Appointment process	DC When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		discharge into the all three canals.	be constructed by a competent staff or sub-contractor to keep running the canals during work activities, as routine.					
B- WATER RESOURCES								
14	**Construction of Coffer Dams**	**Contamination:** Contamination of the river water from soil material during construction and removal of the coffer dams may consequently affect the aquatic life, particularly downstream fisheries.	14.1 Ensure that soil material used for the construction/dismantling of the coffer dam should not contaminate the river water in terms of suspended solids, pH, oil based material to impact adversely on the aquatic life, particularly downstream fisheries by adopting good engineering practice.	CEnv	CSCEnv PMO-ESU	Compliance with method statement Site Inspections	DC, AC During construction/ dismantling of the coffer dam Once a month	BOQ
			14.2 Carry out water testing to ensure the	CEnv	CSCEnv PMO-ESU	Laboratory based and on	DC Monthly	Direct Cost

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			setting up /dismantling and operation of the cofferdam do not adversely impacting of control water bodies (river, canals). DO TDS tests will be conducted at coffer dam U/s and D/s area on daily basis.			site Water testing of control water	basis of onsite testing Quarterly basis of laboratory base testing	
			14.3 The Contractor will consult with the environmentalist of the Supervision Consultant to get the approval of construction/dismantling process and location of the cofferdam.	CEnv	CSCEnv PMO-ESU	Compliance	BC/DC At the set up and dismantling Cofferdam	BOQ
15	**Batching Plant**	**Use of water:** Preparation of concrete at the batching plant would need water free from sediments and	15.1 Ensure that pumping of the ground water will not affect the private or public tube well in the	CEnv	CSCEnv PMO-ESU	Compliance	BC Before establishing new tube well	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		high salt concentrations, particularly sulphates. Ground water in vicinity of the river will meet this requirement. Therefore, the contractor will install tube well at the site to meet this requirement. Water may also be needed for curing the concrete. For this the contractor will use river water. **Disposal of waste water:** Waste water generated from the batching plant will be loaded with cement and fine aggregate. Disposal of this water into the river will affect the water quality and consequently affecting	near vicinity.					
			15.2 Ensure that contractor uses the water free from sediments and high salt concentration for the preparation of concrete at the batching plant.	CEnv	CSCEnv PMO-ESU	Compliance	DC When required Daily	BOQ
			15.3 Ensure that wastewater or surface runoff generating during rain from the batching plant should not enter in to the river without treatment.	CEnv	CSCEnv PMO-ESU	Site Inspections	DC Daily When required	BOQ
			15.4 Ensure the effluent meet the NEQS level through impounding or other type of treatment before this is disposed off in to the river.	CEnv	CSCEnv PMO-ESU	Compliance with contractual obligation. Effluent testing (if generated)	DC When required Monthly basis	BOQ
			15.5 Ensure that	CEnv	CSCEnv	Compliance	DC	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		the aquatic life. The suitable site for the batching plant is indicated on figure 3.1.	Engineer to oversee that the control the clause relating to batching plant are complied by the contractor		PMO-ESU		Daily	
16	**Drinking Water Supply & Wastewater Generated from Contractor's Camp & Workshop**	**Water consumption:** The contractor shall arrange for water supply at the camp for human consumption as well as for the use at work shop for washing and otherwise. This may be required from the existing water resource available with PID for the use at the colony or install a new tube well. The arrangement will be made in consultation with Consultant and PMO. **Disposal of waste**	16.1 Ensure water source for domestic use i.e. camp site tap(s) or extraction well will be monitored	CEnv	CSCEnv PMO-ESU	System in place Water testing	DC Quarterly basis	Direct Cost
			16.2 Ensure that drinking water standard should be maintained while supplying water to the labour camp and also regular water testing and monitoring should be done	CEnv	CSCEnv PMO-ESU	Compliance with drinking water NEQ standards	DC Quarterly testing	BOQ Direct Cost
			16.3 Ensure that local water supplier is compensated for the water if extracted from the existing water	CEnv	CSCEnv PMO-ESU	Compliance	DC When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		water and other waste effluents: The contractor's camp will generate wastewater from two sources, viz., residential area and workshop. Both the wastewaters will have different types of contaminants, i.e. domestic wastewater contains human excreta while the workshop waste water will have oil and grease. Disposal of untreated wastewater into the river may pollute river water and affect the aquatic life.	supply system for the community					
			16.4 The contractor will provide wastewater treatment facilities separately for both types of wastewater (domestic wastewater & construction wastewater).	CEnv	CSCEnv PMO-ESU	Compliance with contractual obligation	DC Daily When required	BOQ
			16.5 Ensure that sewage and other waste effluents are handled properly to avoid contaminating the control water bodies	CEnv	CSCEnv PMO-ESU	Compliance of contractual obligation Effluents testing	BC, DC At the design stage of waste treatment system Quarterly Basis	BOQ
17	**Electrical & Mechanical Work**	Renovation of electrical and mechanical installations of the existing barrage will be carried out in situ.	17.1 Ensure good housekeeping to avoid any accidental spill or leakage into the river.	CEnv	CSCEnv PMO-ESU	Site inspection by the technical staff	DC When required Daily	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		Accidental spill or leakage of chemicals or oil based material could contaminates the river water and adversely affect the aquatic life.	17.2 The contractor will provide suitable working platform e.g. scaffolding or mobile working tower, if require to avoid accidental spill.	CEnv	CSCEnv PMO-ESU	Compliance Site inspection	DC When required Daily	BOQ
C- AIR QUALITY AND NOISE POLLUTION								
18	**Dust, Smoke and Other Potential Pollutants from Plants & Equipments**	A vast variety of construction plant and machinery including but not limited to bulldozers, dumpers generators, batching plant and vehicles will be used during the construction phase. These construction activities will generate dust, smoke and other potential pollutants in the air.	18.1 Ensure that all equipment and vehicles used during the project are properly tuned and maintained in good working condition, in order to minimize the exhaust emissions.	CEnv	CSCEnv PMO-ESU	Monitoring gaseous emission rates from generator and other key equipment	DC Quarterly basis Noise level When required	BOQ
			18.2 If the selected site for batching plant is closer than 500m from the build-up area then it should be ensured that **zero emission** plant is installed.	CEnv	CSCEnv PMO-ESU	System in place	BC Once at start of the work	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			18.3 Ensure that dust emissions due to vehicular traffic are minimized by reducing speed, vehicular traffic minimized through good journey management and water sprinkling on non-metalled road When required.	CEnv	CSCEnv PMO-ESU	Visible dust: Visible observation of size of dust clouds	DC Daily During peak Construction Period. Surprise visit Once a week	BOQ
			18.4 Ensure that periodic Ambient air quality is monitoring to assess the concentration of Carbon Monoxide (CO), Carbon Dioxide (CO_2), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2) and Particulate Matter / (PM_{10}) in the atmosphere.	CEnv	CSCEnv PMO-ESU	Compliance	DC Quarterly basis	Direct Cost
19	**Smoke from**	It is a Contractor's	19.1 Contractor's	CEnv	CSCEnv	Compliance	BC	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
	Burning of Waste Material or Burning of Firewood in the Labour Camp	responsibility to provide clean source of fuel i.e. sui gas such that the site worker do not burn wood as fuel. Burning special waste (clinical waste, packaging waste etc.) may emit poisonous or hazardous emission.	obligations to provide gas as clean source of energy at contractor's camp and not allow them to use wood as fuel.		PMO-ESU	contractual obligations	Once at the start of work DC Once a week	
			19.2 Ensure that all the combustible non-hazardous waste material should be burnt in the burn pit only.	CEnv	CSCEnv PMO-ESU	System in place	DC Daily When required	BOQ
			19.3 Ensure that the quantity of waste burnt at one time is managed so as to minimize smoke emission.	CEnv	CSCEnv PMO-ESU	Maintain record	DC When required	BOQ
			19.4 Control fuel consumption and minimize its waste or leakage by regular monitoring.	CEnv	CSCEnv PMO-ESU	Maintain record	DC When required	BOQ
20	**Noise Pollution from**	The use of old/outdated machinery may raise	20.1 It is the contractor's obligation	CEnv	CSCEnv	Compliance with the	DC Daily	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
	Construction Activities	the noise level during the construction phase. The contractor will use the appropriate machinery to carry out the work.	to use appropriate machinery fit for purpose		PMO-ESU	contract	When required	
			20.2 Ensure the minimum use of vehicle horns particularly during embankments strengthening work along the pond area.	CEnv	CSCEnv PMO-ESU	Compliance	DC Daily When required	BOQ
			20.3 Ensure the implementation of the 30km/h speed limit on site.	CEnv	CSCEnv PMO-ESU	Compliance	DC Daily When required	BOQ
			20.4 Ensure that periodic noise monitoring is undertaken to access the noise pollution during working hours.	CEnv	CSCEnv PMO-ESU	Noise Monitoring	DC Monthly basis When required	Direct Cost
D- BIOLOGICAL RESOURCES								

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
21	**Damage to Biological Resources During Construction**	Barrage pond area may be considered as wetland but it is not a classified wetland. Almost all the work activities are proposed to take place outside the Barrage pond area. For other project activities contractor may require to clear vegetation from the areas to be used for: - Borrow material - Establishing Contractor's Camp - Erecting Batching Plant - Haulage Tracks including Guide banks Bela removal may adversely impact the wildlife of the area due to noise and heavy	21.1 When aligning the access roads, ensure that the chosen route requires minimum vegetation loss and no tree cutting.	CEnv	CSCEnv PMO-ESU	Compliance	BC Once at the time of aligning of access road	BOQ
			21.2 Ensure wood and shrubs are not used as fuel during construction phase.	CEnv	CSCEnv PMO-ESU	Compliance with IEE/EMP	DC Daily Once a month	BOQ
			21.3 Ensure that there is no open defecating in the vicinity of camps or construction site.	CEnv	CSCEnv PMO-ESU	Compliance with Waste Disposal Plan	DC Daily When required	BOQ
			21.4 Ensure that no fire arms are carried out by any of the employees or labour, except designated security staff if require.	CEnv	CSCEnv PMO-ESU	Compliance Site inspection	DC Daily When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		machinery movements.	21.5 Ensure that safe driving practices are observed so that the accidental killing of reptiles or small animals crossing the road could be avoided.	CEnv	CSCEnv PMO-ESU	Compliance with IEE/EMP Endorse speed limit	DC Daily When required	BOQ
			21.6 Ensure that damage to the natural topography and landscape is kept as minimum as possible.	CEnv	CSCEnv PMO-ESU	Compliance with Environmental protection Act	BC/DC Daily When required	BOQ
			21.7 Ensure that no-hunting, trapping and or harassing wildlife. The wildlife protection laws will be strictly implemented.	CEnv	CSCEnv PMO-ESU	Compliance with wildlife protection rules & regulation	BC/DC Daily When required	BOQ
			21.8 Ensure that the illegal fishing in the river by the project staff is prohibited.	CEnv	CSCEnv PMO-ESU	Compliance with Fishery roles & regulation	DC Daily When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			21.9 Ensure that the general awareness of the crew is enhanced regarding the wildlife, through environmental training and notice boards.	CEnv	CSCEnv PMO-ESU	Compliance with Environmental and Wildlife Protection laws	DC Daily When required	Direct Cost
			21.10 Ensure that no project vehicle or staff is allowed to access the restricted areas due to interfere with security and wildlife habitat	CEnv	CSCEnv PMO-ESU	Site inspections Fenced the contractor's facilities	DC Daily When required	BOQ
			21.11 Ensure that shouting permit should not be given by the Wildlife Department for the shooting in Barrage pond area during the construction phase.	CEnv	CSCEnv PMO-ESU	Consultation with Wildlife Department	DC When required	BOQ
			21.12 Ensure that site workers are protected from harmful species	CEnv	CSCEnv PMO-ESU	Compliance with mitigation measures as	DC Daily When	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			of animals			explained in IEE	required	
E- SOCIO-ECONOMIC AND CULTURAL ISSUES								
22	**Health & Safety Impacts on Site Work Force and Local Population**	**Population at risk:** Since the main settlement is located far from the project site, therefore it is unlikely to emplace any health & safety hazards for the local population due to the project activities. However there will be safety and health hazards for the work force, particularly for the people working on the repair/ renovation of gates and hoists and installing electric equipments under the condition of full impoundment of the barrage pond	22.1 The contractor will impart to the training to the workers on safety matter	CEnv	CSCEnv PMO-ESU	As per contract	BC/DC When required	Direct Cost
			22.2 Ensure that Compliant Management Register and Accident Record Register is maintained at Camp site office	CEnv	CSCEnv PMO-ESU	Maintain Record Compliance	DC Daily When required	BOQ
			22.3 Ensure that no machinery is left unattended at working site	CEnv	CSCEnv PMO-ESU PMO-ESU	Maintain plants log sheet Site inspections	DC Daily When required Once a month	BOQ
			22.4 Ensure PMO representative visits monthly to gather complaints from Social/Environment	PMO-ESU	CSCEnv PMO	Maintain Complain Management Register	DC Daily Monthly basis	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			Complaints Management Register and provide feedback to the community on the status of the previous complaints to the community elders					
			22.5 Ensure the use of horns is prohibited, except when necessary.	CEnv	CSCEnv PMO-ESU	Display sign boards Compliance	DC Daily When required	BOQ
			22.6 Ensure all entry points into the construction area are to be staffed 24 hours a day.	CEnv	CSCEnv PMO-ESU	Compliance Provision of 24h security	DC Daily When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			22.7 Ensure that safe driving practices are adopted, particularly while passing close to settlements. This includes a speed limit of 40km/h within built up (residential area) and 30km/h on site.	CEnv	CSCEnv PMO-ESU	Implementation of traffic management plan	DC Daily When required	BOQ
23	**Existing Service Facilities like Education, Health, Electricity, Drinking water Supply and Public Gathering, Religious Congregations etc.**	Social consultation will be done and all impacts influencing the communities will be defined and all these factors will be added and incorporated in the contract document of the contractor and SFA of the communities	23.1 Service facilities may be legalized through SFA.	CEnv	CSCEnv PMO-ESU	Contractor's obligation defined in contract data Compliance of SFA	DC Daily When required	SFA
			23.2 Ensure that women of the area are consulted and their point of view incorporated regarding the project activities and community development projects.	CEnv	CSCEnv PMO-ESU	Gender Analysis	BC, At the preparation of IEE DC Quarterly basis	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			23.3 Ensure that religious congregations must be observed carefully in order to avoid conflicts with tribal leaders and local communities.	CEnv	CSCEnv PMO-ESU	Public Consultation	BC At the preparation of IEE DC When required	BOQ
			23.5 Contractor's camp should include but not limited to the following facilities Mosque, Restaurant, Leisure centre, Health & Safety centre and Welfare facilities.	CEnv	CSCEnv PMO-ESU	Contractor's Contractual Obligation.	BC At preparation of contract document	BOQ
24	**Tribal Tension Local Rivalries on Running Canals and Use of Aquatic Life**	Just one month before the start of the construction work social frame work agreement will be made between the community members and the resident engineer. In order to avoid conflicts	24.1 Ensure that polices with direct bearing on project activities are culturally sensitive, in order to avoid conflicts with tribal leaders and local communities and to offset any impact	CEnv	CSCEnv PMO-ESU	Public consultation Compliance of SFA	BC Once at the start of work DC When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		with tribal leaders and local communities mutual consents will be discussed in SFA.	on the local social structure.					
			24.2 Ensure women are informed through traditional means of communication of the presence of foreign men (migrated labour etc.) in their area.	CEnv	CSCEnv PMO-ESU	Compliance Gender Analysis	BC, At the preparation of IEE DC When required	BOQ
			24.3 Ensure that individuals holding titles to private property used in the project (if any) are compensated in accordance with the market rates and all payment are recorded.	CEnv	CSCEnv PMO-ESU	Compliance of SFA & Land Act	BC Once at the start of the work DC When required	SFA
			24.4 Focus on water related issues related to project implementation in regular group meeting with local community.	CEnv	CSCEnv PMO-ESU	Group meetings, Public consultation	BC/DC When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
25	**Adverse Effects on Archaeological Sites, Any Grave yards and Burial Sites**	No important cultural and archaeological site has been found or reported in the area.	25.1 If any archaeological, historical, cultural, religious or grave yard found during the project implementation then the contractor will ensure that no damage to any such sites is caused due to the project activities.	CEnv	CSCEnv PMO-ESU	Compliance with law indicated in chapter 2 of IEE	BC At the completion of IEE DC Daily When required	Direct Cost
			25.2 Ensure that if any such sites are found during the construction stage informed to the site office immediately.	CEnv	CSCEnv	Compliance	DC Daily	BOQ
26	**Public Health & Safety Services at Construction Site**	Due precautions shall be taken by the contractor, at his own cost, to ensure the safety of his staff and labour and, in	26.1 Ensure that a proper Ambulance is available on site on a 24-hour basis during construction phase. The Contractor will	CEnv	CSCEnv PMO-ESU	Compliance	DC Daily When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		collaboration with and to the satisfaction of the local health authority, to ensure that medical staff headed by qualified medical doctor, first aid equipment and stores, sick bay and suitable ambulance service are available at the camp site, housing, and on the site at all times throughout the period of the contract and that suitable arrangements are made for the prevention of epidemics and for all necessary well fare and hygiene requirements.	appoint MBBS doctor and paramedic staff at site on full time basis. The Contractor will also get a hospital on panel for critical injured persons.					
			26.2 Ensure that all materials, gears and equipment (including personal protective equipment) require carrying out the work safely are provided to the staff.	CEnv	CSCEnv PMO-ESU	Compliance	BC/DC Once at the start of work DC Daily	BOQ
			26.3 Ensure that employees must have access to running potable water at their place of work and also shaded area is provided for rest during working shift.	CEnv	CSCEnv PMO-ESU	System in place	DC Daily When required	BOQ
			26.4 Ensure use of horns is prohibited,	CEnv	CSCEnv	Compliance	DC Daily	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
			except when necessary.		PMO-ESU.		When required	
			26.5 Ensure that safe driving practices are adopted, particularly while passing close to settlements. This includes a speed limit of 40km/h within built up area and 30km/h max. speed limit on site	CEnv	CSCEnv PMO-ESU	Compliance Traffic Management Plan	DC Daily When required	BOQ
			26.6 Ensure to provide group insurance to workers and labours at site or in the camp, against accidents, mishaps or loss of life on duty	CEnv	CSCEnv PMO-ESU.	Compliance	DC Daily When required	BOQ
27	**Employment Opportunities**	The project will open new jobs opportunities which the local population could avail. PID may request the contractor to hire labour	27.1 Ensure maximum (up to 100%) unskilled and possible semi skilled and skilled jobs are to be provided to people	CEnv	CSCEnv PMO-ESU	Compliance with labour laws in contract documents	BC At the stage of employment DC When	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		from the local community It is believed that substantial amount of unskilled work force for construction could be recruited from the local population near the project site. Therefore Barrage construction will have a positive impact on the socio-economic fabric of the local society. The Contractor will evaluate the available manpower taking into consideration the level (skilled or unskilled) and numbers of the workers who could be inducted in the labour/ work force of the Project. The Contractor will give preference to	from local communities, provided the suitable competent persons with required qualification/experience are available.				required	
			27.2 Ensure project staff interaction with local community is minimized.	CEnv	CSCEnv PMO-ESU	Land selection for labour camp should be at least 500m away, physical barrier between work area and public places	BC During preparation of IEE DC When required	BOQ
			27.3 Ensure that inter tribal balance is maintained when giving employment to the local population. Preference to be given to the people directly affected by the project.	CEnv	CSCEnv PMO-ESU	Public Consultation	BC At the stage of employment DC When required	BOQ
			27.4 Ensure that	CEnv	CSCEnv	Public	BC	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		employing suitable personnel living close to the Project area on the conditions which will be in accordance with the National Law ensuring that the working conditions for the labour / work force at the site take due care of the health, safety and ambient conditions conducive to appropriate working/living standards applicable to a work site.	guidelines are prepared and implemented to sensitize non-local labour to local norms and customs in order to minimize cultural tensions.		PMO-ESU	Consultation	at the stage of employment DC Quarterly	
			27.5 Ensure that field crew is medically screened before employed.	CEnv	CSCEnv PMO-ESU	Compliance with PHS Act	BC At the stage of employment	BOQ
28	**Communicable Diseases**	The labour(s) at camp, their interaction with truck drivers and alike personnel are potential places for spread of communicable diseases if the incidence exists.	28.1 Ensure that periodic awareness campaign for Hepatitis, HIV/AIDS and other communicable diseases like cholera, typhoid and	CEnv	CSCEnv PMO-ESU	Compliance with PHS Acts, health & safety awareness courses	DC Quarterly When required	Direct Cost

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		Almost 100% of the people of project area and the potential labour are not aware of the source, mode of communication or consequences of Hepatitis, HIV/AIDS. Although their religious and cultural value system, to a large extent excludes the outbreak or rapid communication of HIV/AIDS, yet its occurrence in such a situation cannot be precluded. It is necessary that along with other communicable diseases like Cholera, Typhoid and Tuberculosis, awareness and	tuberculosis is undertaken for the project staff					
			28.2 Ensure that a risk assessment of spread of HIV/AIDS is undertaken in the project area on the basis of data from the Punjab HIV/AIDS program.	CEnv	CSCEnv PMO-ESU	Medical testing of site worker	BC At the employment DC Quarterly basis	BOQ
			28.3 The medical staff ensure periodical checks of the cooking staff and cooking practice particularly for symptoms of hepatitis A.	CEnv	CSCEnv PMO-ESU.	Medical Testing	DC When required	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		preventive campaigns are run from time to time in the labour camps and the field offices of the project on HIV/AIDS.						
29	**Restoration/ Rehabilitation**	It will be the requirement of the contract that restoration of borrow areas will be done at completion of the work. All borrow areas will be levelled as far as possible, graded and brought in a level form resembling to natural condition prior to extraction / borrowing. Campsite and temporary facilities will be restored in accordance with contractual obligations and requirements. All the community roads and bridge roads which were under contractor use will be restored to their original shape or	29.1 Ensure that all borrow sites are remediated as per contract requirements.	CEnv	CSCEnv PMO-ESU	Compliance Photograph record	After completion of excavating work	BOQ
			29.2 Camp site is restored and changed to tourist resort if possible and agreed by the PID.	CEnv	CSCEnv PMO-ESU	Compliance	After completion of work	BOQ
			29.3 All extra products / material, solid and liquid will be disposed off in accordance with the requirement of the EIA/ EPA and contract document.	CEnv	CSCEnv PMO-ESU	Compliance with Waste Disposal-Plan	After completion of work	BOQ
			29.4 All fencing and access gates relevant to construction activities will be removed.	CEnv	CSCEnv PMO-ESU	Compliance with restoration guidelines	After completion of work	
			29.5 All pits (including burn pits, sumps and	CEnv	CSCEnv PMO-ESU	Compliance	At completion	BOQ

Sr. No.	Project component	Description	Measures / Actions	Responsibility		Parameters for Monitoring	Frequency	Cost
				Executor	Monitor			
		better.	depression) will be backfilled unless agreed with the CSCEnv.				of work	
			29.6 The portion of the access track likely to be of no use for other activities will be restored by removing culverts and gravel topping.	CEnv	CSCEnv PMO-ESU	Compliance	After completion of work	BOQ
			29.7 While abandoning sumps the extra cap of soil will be placed over them to allow for compaction.	CEnv	CSCEnv PMO-ESU	Compliance with restoration guidelines	After completion of work	BOQ
			29.8 Ensure that no potential conflicts should emerged with landowners during the restoration of the borrow areas.	CEnv	CSCEnv PMO-ESU	Compliance with SFA	After completion of work	SFA

7.5 INSTITUTIONAL ARRANGEMENT

7.5.1 Management Responsibilities

276. Overall responsibility for environmental management will rest on Head PMO of the Irrigation Department, Government of the Punjab as per the following framework:

i.	The Executing Agency	PMO of Punjab Irrigation Department (PID)
ii.	Supervising and Monitoring Agency	Environmental Unit of PMO.
iii.	General Assistance to all above agencies in their respective tasks	Head PMO/The Project Director, Punjab Irrigation Department will facilitate communications, logistics and data collection as and when required.
Iv	Logistic Support	Head PMO/The Project Director, Punjab Irrigation Department shall provide the logistic support and shall be the focal point for the construction activity.

7.5.2 Project Organizational Structure

277. The organizational structure for the environment management / monitoring implementation is shown below. The role of the organization is described in **figure 7.1**.

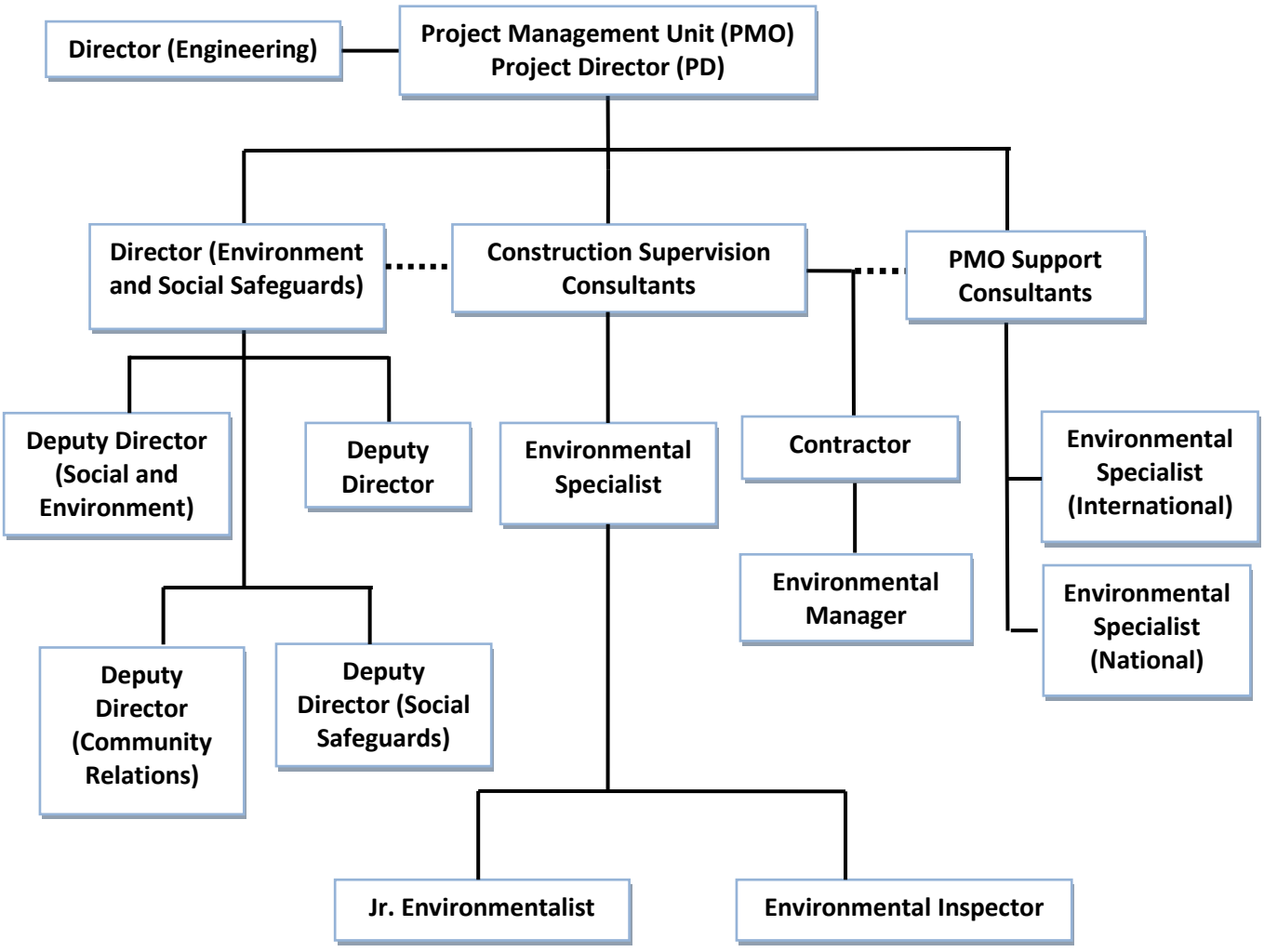

Figure 7-1 Organization Chart for Environment Management/Monitoring Implementation

(i) Project Management Office (PMO)

The overall responsibility for the implementation of Environmental Management/Monitoring Plan rests with the Project Management Office (PMO), with the assistance of Environmental Unit (ESU) of PMO. The ESU consists of Director Environment & Sociology, Deputy Director Environment and Deputy Director Sociology. Construction Supervision Consultant (CSC) will assist and advise PMO in implementation of EMP.

PMO will assume overall responsibility for ensuring that;

- While executing the contract and undertaking the construction all environmental norms, regulations and requirements promulgated by Pakistan Environmental Protection Council (PEPC), Pakistan Environmental Protection Agency (PEPA), Environmental Protection Agency (EPA) Punjab and particularly Asian Development Bank environmental safeguard policy, with respect to the work site and adjacent areas are fully respected and implemented.
- Contractor and Construction Supervision Consultants appoint a dedicated environmental officer and allied staff. PMO will also ensure that all environmental personnel are authorized to implement the socio- environmental policies and requirements of the EMMP.
- It will coordinate with relevant government departments and stakeholders on concerned socio-environmental issues.
- It will inspect and monitor residual impacts of the rehabilitation work and observe documentation of the impacts during the construction phase.
- It will inspect the significance of impact in case of unanticipated change in the project.

(ii) Environment Unit (ESU) of PMO

- Environmental Unit (ESU) within PMO will monitor Project performance.
- ESU will function in coordination with the Construction Supervision Consultants and will receive reports from them on behalf of PMO.
- ESU will prepare and submit periodical Progress and Monitoring Reports to all stakeholders as per their schedules. In this task they will seek assistance/ guidance from Construction Supervision Consultants as and when required.

(iii) Head PMO/The Project Director

The Project Director shall provide or arrange the logistics including communication, transport and accommodation to all visiting persons/teams experts and from any of the above monitoring units and shall coordinate with the contractor(s) to facilitate the visits/inspections. For all Monitoring and Evaluation activities in the field the Engineer's Representative shall act as the focal point.

(iv) Contractor

The Contractor will be responsible for the implementation of the project EMP. The Contractor will ensure that EMP for the project is implemented fully and integrated into the Project implementation and being integral part of the contract document. For any default damages so caused will be remediated by the contractor at his own cost and expenses. In case the Contractor fails to rectify the damage the employer will do the need full at risk and cost of the Contractor. The amount will be determined by the Construction Supervision Consultants which

will be adjusted from the amount due to the contractor. The Contractor will also be responsible for communicating with and training of his staff in environmental aspects and implementation of the EMP. The Contractor will develop and get approval of Health, Safety & Environment (HSE) Plan, Waste Management Plan, Traffic Management Plan, Haulage Routes Plan and Borrow Area Plan from Construction Supervision Consultants (CSC) before the commencement of the Physical works on site.

(v) Construction Supervision Consultants

The construction supervision consultants will be responsible to ensure quality of work and fulfilment of contractual obligations. Environmental Specialist of the design construction supervision consultants will ensure that all the environmental and social provisions are complied with and the works performed meet the applicable quality standards. He / She will confirm that the day-to-day construction activities are carried out in environment friendly manner. He/She will also organize periodic environmental training programmes and workshops for the Consultant's and Contractor's staff.

Exhibit 1 - Responsibilities of PMO Environmental Unit, Contractors, Monitoring and Environmental Specialist of the Construction Supervision Consultants

Organization	Designation	Responsibilities	Operating Documents
Project Management Office (PMO)	Director Socio / Environment	▪ Overall incharge of the environmental unit. ▪ Oversee the works of environmental and social aspects related to the project(s) for Punjab barrages rehabilitation. ▪ Provide environmental and social guidance to environmental staff in project preparation and approval / sanctions, constructions, implementation, to attain optimum efficiency and success in the management and operation of the project. ▪ Assist Project Director in active inter-action with donors, consultant, contractors and other stake holders on monthly review, progress of the project or any other situation required immediate action. ▪ Time management for successful completion of the project and its scheduling according to approved budget. ▪ Preparation of all necessary reports required to be submitted to Govt. or donor agency. ▪ Ensure compliance and implementation of rules and regulations issued by the Federal Agencies especially regarding social and environmental aspects. ▪ Project planning, monitoring and evaluation specifically in environmentally & social related matters in the project.	▪ Contract with Punjab Irrigation Department ▪ Relevant Asian Development Bank documents on environmental and other laws discussed in EIA/IEE of Panjnad Barrage ▪ EIA/IEE for the Panjnad Barrage ▪ EMP of Panjnad Barrage ▪ Social Framework Agreement (SFA) ▪ Consultant's Environmental Reports ▪ Comply with National, International and Punjab Public Health and Safety (PHS) Acts
Project Management Office (PMO)	Deputy Director Environment	▪ Assist Director Socio, environment in office assignment and field as well. ▪ Full fill the obligation as laid out in his/her contract with Punjab Irrigation Department. ▪ Ensures environmental protection during the project	▪ Contract with Punjab Irrigation Department ▪ Relevant Asian Development Bank documents on environmental and other laws discussed in EIA/IEE of Panjnad

Organization	Designation	Responsibilities	Operating Documents
		implementation according to Environmental laws, policies guidelines and technical standards ▪ Liaison with contractor and consultants environmental team ▪ Conduct site visits to ensure compliance with EIA/IEE and EMP ▪ Coordinate with stakeholders, including general community, EPA, WWF, Asian Development Bank, contractor, consultants and others ▪ Support DD Sociology in fulfilment of his/her responsibilities	Barrage ▪ IEE for the Panjnad Barrage ▪ EMP of Panjnad Barrage ▪ Social Framework Agreement (SFA) ▪ Consultants' Environmental Reports ▪ Comply with National, International and Punjab Public Health and Safety (PHS) Acts
Project Management Office	Deputy Director Sociologist	▪ Assist Director Socio, environment in office assignment and field as well. ▪ Carried out the responsibilities of official spokesperson of the PMO on social aspects. ▪ Deals with social mobilization and emerging socio-economic issues. ▪ Coordinate with stakeholders, including general community, EPA, WWF, Asian Development Bank, contractor, consultants and others. ▪ Review all socio-environmental reports and ensure implementation of corrective measures, if any ▪ Conduct site visits to ensure compliance with EIA/IEE and EMP ▪ Support DD Environment in fulfilment of his/her responsibilities	▪ Contract with Punjab Irrigation Department Relevant Asian Development Bank documents on social aspects and other laws discussed in EIA/IEE of Panjnad Barrage. ▪ Socio-economic survey as a baseline for EIA/IEE of Panjnad Barrage ▪ The present EMP of Panjnad Barrage ▪ PHS Acts ▪ Social Framework Agreement (SFA) ▪ Consultant's Socio-Environmental Reports ▪ Documentation received from the field ▪ Comply with HSE Acts ▪ Social Framework Agreement (SFA)
Construction Supervision Consultant	Environmental Specialist	▪ Ensure the implementation of the mitigation measures suggested in the EMP ▪ Monitor construction activities as per the compliance monitoring program ▪ Monitor the impacts of the project activities (effects monitoring, discussed later in	▪ Contract with PMO ▪ IEE for Panjnad Barrage ▪ The EMP of Panjnad Barrage ▪ Comply with HSE Plan

Organization	Designation	Responsibilities	Operating Documents
		this document) ▪ Liaison with environmental officers and HSE officer ▪ Manage and implement environmental mitigation measures, as well as PID Department and contractor's health and safety Policies ▪ Manage operation of the contractor's environmental management staff ▪ Give training to the staff on environment awareness	
Contractor	Environmental officer / HSE officer	▪ Manage and implement environmental mitigation measures contractor's health and safety Policies ▪ Liaison with consultant supervision consultant's environmental specialist. ▪ Manage operation of the field environmental staff ▪ Train the staff as required ▪ Implementation of EMP ▪ Cause and effects, and compliance monitoring.	▪ Contract with Punjab Irrigation Department ▪ IEE for Panjnad Barrage ▪ EMP of Panjnad Barrage ▪ Comply with PHS Acts ▪ Consultant's environmental reports. ▪ Social Framework Agreement (SFA)

7.6 CHANGE MANAGEMENT

278. An environmental assessment of the proposed project has been made during the preparation of IEE. However it is possible that change in project design may be required when the project is implemented. This section describes the mechanism to handle changes that might affect the project environmental impact. The changes in the project design may be grouped into three orders:

First Order Change is one that leads to a significant departure from the project described in the EIA/IEE such as change in project location and project design. The change management statement (CMS) will be submitted to EPA for approval with a copy to the Asian Development Bank.

Second Order Change is one that is not significantly different from those described in the EIA/IEE such as;

- Increase in project personnel by 25%
- Changes in the documentation and communication, stakeholders consultation program

279. The change management statement (CMS) will be submitted to EPA for information with a copy to the Asian Development Bank.

Third Order Change is one that is of little consequence to the EIA/IEE findings, such as;

- Re-aligning a particular section of road to avoid cutting tree

280. The assessment report will be compiled and recorded.

7.7 COMMUNICATION AND DOCUMENTATION

281. Communication and documentation is an essential feature of EMP. The key features of such mechanism are:

7.7.1 Data Recording and Maintenance

282. All forms to be used for recording information during the environmental monitoring will follow a standard format which will correspond to the data base in to which all the gathered information will be placed. Check boxes will be used as much as possible to facilitate data entry. Tracking system will be developed for each form. The checklists are provided in Appendix 7.1.

7.7.2 Storage of Information

283. The database to be maintained may include the following information:

- Training programs;
- Staff deployment;
- Non-compliances;
- Corrective actions;
- Environmental data listed below:
  - Soil and land pollution
  - Disposal of excavated silt and earth
  - Disposal of waste

- Water resource
  - Quality
  - Quantity
  - Fuel oil and chemical spills
- Vegetation record
- Record of wildlife
- Noise pollution
- Air and dust pollution
- Socio-economic data

7.7.3 Meetings

284. The following environmental meetings during the project will take place

- Primary meeting for setting out the requisite framework for the regular meetings
- Scheduled meetings between Contractor and Supervising Consultant
- Progress review meeting among ESU of PMO, Environmental Specialist and Environment Officer

285. The purpose of the meeting will be to discuss the conduct of the operation, non – compliances noted by the consultant's environmental team and measures for their remedy. The meeting will be recorded in the form of a daily/monthly environmental report.

7.7.4 Reports

286. The Environmental Specialist of the Supervision Consultant shall produce periodical reports as well as inspection notes based upon the visits to the Project site. This information shall make a basis for ESU for their further reporting or visiting the site. All reports shall be location and activity specific. The reports shall especially identify areas of contractor's non-compliance with the EMP and provide guiding remarks on actions to be taken. The significance of the non-compliances shall also be noted. Copies of these reports shall be sent to the Resident Engineer (RE) who shall forward them to the Team Leader, Head PMO, Punjab Irrigation Department and the Contractor for their action(s).

287. The RE will include in his routine reports a summary status of activities relating to the EMP. Supplemental reports on issues should also be prepared as and when required.

288. The consultant' s environmental team will produce daily ,monthly, and annually reports, as well as a final report of the project based on the information collected. The list of distribution reports is given in **Exhibit-2**.

Exhibit-2 Periodic Reports

Report	***To be Prepared by***	***To be Reviewed by***	***Distribution***
Daily	-Contractor's HSE officers	-Contractor environmental officer -Consultant's Environmental Specialists	-Resident Engineer
Monthly	-Environmental officer of the Contractor	-Consultant's Environmental Specialists	- Resident Engineer -PMO
Quarterly	-Environmental team of the Construction Supervision Consultants	-ESU of PMO	-Resident Engineer -PMO -PID - EPA Punjab -ADB
Annually	-Environmental team of the Construction Supervision Consultants	-ESU of PMO	- Resident Engineer -PMO -PID -EPA Punjab -ADB
Effects Monitoring	-Environmental team of the Construction Supervision Consultants	-ESU of PMO -EPA Punjab	-Resident Engineer -PMO -PID -EPA Punjab -ADB
Change Management	-Environmental team of the Construction Supervision Consultants	-ESU of PMO -EPA Punjab	-Resident Engineer -PMO -PID -EPA Punjab -ADB
Final	-Environmental team of the Construction Supervision Consultants	-ESU of PMO	-Resident Engineer -PMO -PID -EPA Punjab - ADB

7.7.5 Photographic Record of the Project Area

289. Key locations shall be identified for taking Photographs of the project area by using digital camera to Photograph of the project area before the construction start and Recording the following information for each shot on a form:

- Shot number
- Name of Photograph Date
- Time
- Featured Photograph
- Other observations

290. Repeating the above after completion of all activities for selected location shall be ensured

7.7.6 Social Complaints Register

291. The contractor's environmental team will maintain a social complaint register at camp site office to document all complaints received from the local communities. The register will also record the measures taken to mitigate these concerns. The final report will be communicated to Environmental section of PMO. The details of Grievance Redress Mechanism are provided in the RAP. The Project Monitoring team shall carry out the monitoring of the implementation of social and environmental mitigation measures as per ADB Safeguard Policy Statement.

7.7.7 Record Register

292. The environmental specialist of the construction supervision consultants will be responsible to maintain and update all environment related data, record and documents. The results from environment monitoring and sampling program should be fully documented and recorded. The results will be available for inspection by the regulatory authorities and Asian Development Bank on site. The record should provide the following quality assured monitoring and sampling information.

- Parameters monitored and sampled
- Specified details of measurements/samples to support analytical and quality assurance (QA) requirements e.g. dates, times, location, other relevant parameters
- Results of measurements/sample analysis, with minimum error.
- Interpretation and review of results against specified trigger level

293. This will be maintained at a site to document any change in the project design as well. These changes will be handled through the change management mechanism if any. The final report will be communicated to ESU. Environmental issues Tracking Report form will be completed and maintained by the Contractor which is provided in Appendix 7.2.

7.8 TRAINING MODULE

294. The training will be given to the different professional groups separately such as manager level group, work supervisors, skilled/unskilled labor etc. The training will help ensure the Project workers understand and follow the EIA/IEE and EMP. A Training plan of 10 sessions which will be finalized before the commencement of the project is given below:

Training Plan

Trainee	Trainer	Contents	Schedule
Selected field staff of PMO and Supervision Consultant	ESU Specialists; Environmentalist of Supervision Consultant	Environmental and social aspects, particularly sensitivities of the project; Key finding of the IEE; Social and cultural values of the area; Leadership dynamics	Before construction activities
All site personnel • Contractor: Managerial staff, Engineers, Environment, Social, Health and Safety staff • Consultants: Managerial staff and Engineers	Environmentalist of Supervision Consultant	Environmental and social aspects, particularly the sensitivities of the project; Wildlife and vegetation related sensitivities of the project; Key finding of the IEE; Mitigation measures; Contingency plan; Community issues; Social and cultural values of the area	Before and during construction stage
Construction crew	Environmentalist of Supervision Consultant and Environmental Officer of Contractor	EMP; Waste disposal plan; HSE plan	Before and during construction stage
Drivers	Environmental Officer of Contractor	HSE plan; Road safety; Road restrictions; Vehicle restrictions; Defensive driving; Waste disposal; Social and cultural values of the area	Before and during the construction
Camp staff	Environmental Officer of Contractor	HSE plan; Camp operation; Waste disposal; Natural resource conservation; Housekeeping	Before and during the construction
Restoration team	Environmentalist of Supervision Consultant	Waste disposal; Site restoration; Leveling and restoration of borrow area	Before the start of the restoration activity

7.9 WASTE DISPOSAL PLAN

295. This component describes the waste disposal plan that will be employed during the construction and restoration period. The main types of waste to be disposed off include:

- Waste generated during construction;
- Fuel, oils, and chemicals;
- Sewage;
- Campsite waste;
- Medical waste;
- Demolition waste;
- Packing waste; and
- Excess construction material.

296. Domestic waste and construction waste will be the main type of waste generated from Labour Camp and construction activities. Domestic waste contains high percentage of readily degradable hydrocarbon which gives bad smell on decomposition, especially in hot and humid environment. Construction waste classified as inert waste which could be a problematic to dispose off. It is recommended to collect the domestic waste and construction waste separately. The Contractor will adopt 3 Rs (reduce, reuse and recycle) technique for proper disposal of solid waste.

7.9.1 Domestic Waste

- All the waste generated at Labour Camp should be collected and temporarily stored at the designated bunded area within the labour camp.
- The area should be prepared, maintained and visually inspected and recorded on regular basis by the Environment Officer of the contractor.
- The waste storage area should be fenced to stop animal's direct contact with the waste. The site must be decontaminated to keep the building free from foul smells, spreading of diseases and healthy working environment on regular basis.
- It is the responsibility of Contractor to arrange the waste collection from the Labour Camp with local authority or waste disposal corporation on regular basis.
- Waste Chute should be provided within the Labour Camp. Chute will enable the collection of thrown solid in the covered storage site.
- Biodegradable Bags should be provided to the occupants and residents of the labour camp for collecting their waste.
- Implement resource conservation and recover recyclable waste e.g. paper, steel cans, glass bottles etc. from the collected waste and divert the filtered waste to the area waste disposal pit site.

7.9.2 Construction Waste

- Construction waste could be reused as a fill material or construction material. However the detail testing should be undertaken to confirm the suitability of the waste, if is used as a construction material.

- If the construction waste disposed of on site in the form of construction waste disposal site then once the hole filled with the construction waste the top of the fill should be capped with clayed material and compacted to minimize water infiltration.

297. The waste disposal system is summarized in **Exhibit-3** below.

Exhibit-3 Waste Disposal Plan

Types of waste	Description	Phases	Disposal methods
Construction waste	Crushed concrete & excavated soil	Road Bridge and Barrage structure repair work	Dumping and leveling of waste only on site agreed with the Environmental Specialist and ESU. Waste will be properly disposed off in a manner that does not disturb the natural drainage, soil cover, water quality, air quality and aesthetics of the area. The dumped material will be strengthened by stone pitching.
Fuel, oils, and chemicals spills contaminated soil or wastewater	Contaminated soil or water	All phases	Soil contaminated by minor spills / leakages (defined as leaks from the vehicles, machinery, equipment, or storage containers such that the areas and depth of soil contaminated is less than 1sqft and 3 inches respectively) will be scraped and sent to the burn pit where it will be burned along with other combustible wastes. Moderate spills defined as spills of volume less than or equal to 200 liters will be contained and controlled using shovels, sand, and native soil. These materials and equipment will be made available at camp site and construction site during operation. The contaminated soil will be excavated and stored in a bunded area lined with impermeable base. Depending on the volume of the contaminated soil, the disposal may involve sending it to burn pit or for specialized treatment such as bioremediation or solidification/stabilization (s/s). Major spills of volume exceeding 200 liters will require the initiation of PMO emergency response procedures. These spills will be handled and controlled according to the specialized measures and special treatment as suggested by the spills removal experts. The contaminated water should be collected in separate container and sent to the suitable treatment site after the mutual agreement with environment consultant and PMO.
Sewage and grey wastewater	Wastewater from kitchen and washing areas, sewage	Construction / Operation Phase	Sewage to be disposed off using septic tanks and soaking pits with designed filter bed. Sewage and solid residue to be disposed off in sewage treatment facilities of Muzaffargarh city. The septic tank and soaking pits with filter bed may be designed on per capita basis. Wastewater from kitchen and washing areas to be disposed off in filter bed soaking pits. No any kind of wastewater will disposed off into river or anywhere without prior approval of the Engineer.

Types of waste	Description	Phases	Disposal methods
Camp site waste	Animal, fruit or vegetable residue, domestic garbage	Construction / Operation Phase	Color coded waste collection drums will be placed at the appropriate locations to segregate different types of waste. Recyclable waste to be given away for recycling; and non combustible waste to be buried in waste disposal pit by the local authority of district Muazaffargarh with other city waste as agreed with ESU and Environmental Specialist. Green waste will be disposed off at the composting unit
Medical waste	Syringes, glass bottles, soiled bandages, expired drugs, dressing	Construction / Operation Phase	To be incinerated at nearby hospital incinerator, if any, or an equivalent facility used by nearest major hospital and specified by the Contractor in SSEMP
Workshop waste, and fluid waste	Used oil, ferrous /non ferrous materials, batteries, oil etc.	Construction / Operation Phase	The collection and disposal of oil based waste material should be arranged with specialized certified waste disposal Contractor
Demolition Waste	Concrete, bricks, other building materials	Construction / Operation Phase	Reusable materials to be given away for re-use. Remaining waste to be buried at designated construction waste disposal site which will be specified by the Contractor in SSEMP as per site conditions
Packing waste	Paper, plastic, textiles, cardboard, rubber, wood, glass, tin, cans, aluminum canes	Construction / Operation Phase	Recyclable waste to be handed over to recycling contractors. Non-recyclable waste to be collected and disposed off with other domestic waste generated at Contractor camp and labor camp

7.10 ILLUSTRATED TRAFFIC MANAGEMENT PLAN

298. Mechanical works at the barrage might require partial or full closure of the road bridge during construction. Therefore, traffic management would be required during such time periods spanning long hours in a day. It is a contractor's contractual obligation to prepare a Traffic Management Plan, and submit to get its approval from the Engineer, traffic police, XEN Irrigation and HSE Officer and implement on site. The plan should be available for public in local library and disclose in newspaper. The suggestions made in this section should be incorporated by the contractor in preparation of the Traffic Management Plan.

299. The purpose of traffic management plan is to cope with traffic distribution that call for coordinate actions from several services responsible for road/traffic management on a given road or network.

Barrage Structure Repair Work

300. There is a single carriage way bridge across the main weir at Panjnad Barrage for public transport. If part of the road needs to be used to undertake the barrage structural repair work then the working area should be clearly marked with separating fence. No unauthorized person should be allowed to enter the working area. Following measures should be taken during the construction of the bridge.

- Temporary route should be provided during the bridge construction to maintain traffic flow.
- The temporary route should be adequate for the existing traffic plus the site traffic and designed and built by a specialized contractor.
- The rural roads leading to or passing near the construction site could be used to convey men and materials to the construction sites provided no damage is done to road or private property or crops.
- It is a Contractor's contractual obligation to use the roads and paths carefully and in case of any damage, repair the damaged roads or paths.

Closing one Lane: Traffic light system should be set up when closing down one lane of the road to allow only one side traffic at a time. Sign posts about the new traffic light and/or proposed new road layout should be placed at least one km from the road closing lane. Sign boards about the expected delay in traffic and queue build up should be placed in Ali Pur and Ahmad Pur Sharkia.

Complete Closure of the Road: There is an active river creek at downstream of the barrage and road bridge will be required for alternative route. A boat bridge could be assembled for temporary alternative route for the traffic during the refurbishment of the existing bridge.

301. The Contractor will occupy the bridge in such a way that one lane will remain open for traffic and other lane will be closed for construction activities. The Contractor will mention the closure of bridge in print media, electronic media and local newspaper properly. If the road needs to be closed completely for short period then it is suggested that the closure should not be more than continuous 4 hours. Local traffic police should be informed at-least a week before the closure required. Traffic sign board regarding the closure time and suggestion for

alternative routes should be placed at the exit of main city i.e. Muzaffargarh and Bahawalpur towards the Panjnad Barrage. Where possible the closure should be arranged outside the off peak times (consider peak time from 6am to 10am and 3pm to 7pm). The traffic should be stopped before it enters the built up area near the barrage i.e. settlements near the barrage to avoid the distraction of the local community and damage to infrastructure from the accumulated traffic.

302. Alternate river crossinmg for heavy traffic are available at;

Upstream of Punjnad Barrage

- On Sutluj River- AT Jhaangra on Uch Jalalpur Raod (N115) and aslo at Gharibabad on Bahawalpur-Lodhara Road(N5)
- On Chenab River - Atb Muzaffargarh on Multan – Muzaffagarh Road (N70)

Downstream of Barrage

- On Sindh River at Guddu Barrage on Kashmora – Sadiqaabad Road

Rcommended alternate route for heavy traffic from Karachi to Bahawalpur;

- Karachi -> Sukhar -> Kashmora (N55) cross Sindah River at Guddu Barrage get N5 -> Sadiqaabad -> Rahimyar Khan -> Bahawalpur

Strengthening Embankments Works

303. The existing embankments can be used for transporting soil, material and plant and equipment. However the approximate width of the bunds is 20 ft which may not cope with the traffic on both directions (depending upon the type of vehicles use in earth moving). The crossing/waiting bays should be provided, if required, along the embankments to avoid any accidental slip of vehicles. The soft barricading fence should be provided at the edges of the path/roads etc.

Proposed Traffic Routes for Transportation of Materials

i. Proposed routes for cement carrying loader

Cement is locally available from the factories situated in Mianwali, D.G.Khan, Chakwal, Islamabad etc. However, slag cement and granulated slag are available from Thatta and Zeal Pak cement factories in Sindh. The contractor can purchase the cement from any of the mentioned sources subject to the approval of the Engineer-In charge. The recommended routes for transportation of cement to the construction site are as follow:

i. Mianwali --> Dera Ismael Khan -->Dera Ghazi Khan --> Muzaffargarh (398 km) →Punjnand Barrage

ii. Dera Ghazi Khan --> Karimdad Quraishi --> Muzaffargarh → Punjnand Barrage

iii. Chakwal -->Jhang--> Multan -->Muzaffargarh → Punjnand Barrage

iv. Islamabad --> Jhang --> Multan --> Muzaffargarh → Punjnand Barrage

v. Zeal Pak Cement Factory --> Sukkur --> Shikarpur --> Rajanpur --> Dera Ghazi Khan --> Muzaffargarh → Punjnand Barrage

vi. Thatta --> Dear Ismael Khan --> Dera Ghazi Kahhan --> Muzaffargarh → Panjnad Barrage

ii. Proposed routes for course aggregate/crush carrying loader

Coarse aggregates are available at many sources, such as quarries at Sakhi Sarwar, Margala Hills and Sikhanwali at Sargodha. The following routes may be used for transportation of the aggregate;

i. Sargodha --> Jhang --> Kabirwala --> Muzaffargarh → Punjnand Barrage

ii. Sakhi Sarwar --> Dera Ghazi Khan --> Muzaffargarh → Punjnand Barrage

iii. Margala (Taxila) --> Jhang --> Multan --> Islamabad → Punjnand Barrage

iii. Proposed routes for sands loader

The sand could be extracted from the bed of River Chenab and River Sutluj (if so considered appropriate by the Engineer). There are various local routes to approach the river and could be used for transportation of sand to the work areas.

iv. Proposed routes for steel carrying loader

Grade 60 / Grade 40 reinforcement steel is available from re-rolling mills at Karachi and Lahore (505 Km) which can be purchased with approval from Engineer. The following routes may be used for transportation of reinforcement steel;

i. Lahore --> Okara --> Khanewal --> Muzaffargarh → Punjnand Barrage

ii. Karachi --> Shikarpur --> Rajanpur --> Muzaffargarh → Punjnand Barrage

Contractor's Obligations

304. The following steps have been suggested for proper management of traffic on routes to be used for material transport:

i. The Contractor will display sign boards and banners about traffic diversion at places on detour routes.
ii. He will display at appropriate places particularly near settlements a traffic man to control traffic.
iii. Provision of speed breakers at appropriate places in consultation with/approval of the Engineer In-charge which should be removed after completion of the project.
iv. Obey speed limits as prescribed in Environmental Management Plan.
v. The Contractor will provide copies of his day to day traffic management strategy to the Engineer.
vi. The Contractor will arrange a rescue team and first-aid facility in case of any accident.
vii. The Contractor will keep the smoke emission of the vehicles within NEQS.
viii. Water will be sprinkled on earthen routes to control dust emissions.
ix. No private property without permission of the owner will be used for transportation.
x. Restriction on playing radio/tapes at high volumes.
xi. Restriction on use of noise producing machinery during night near settlements.

7.11 OUTLINE OF EMERGENCY RESPONSE AND CONTINGENCY PLAN

305. If any of the results of the environmental monitoring/sampling exceed specified trigger levels of the monitored parameters, the appropriate actions will be undertaken to prevent hazard to human life, property and the environment outside the operating site bounding control and minimize any immediate risks of pollution of the environments, ensure the immediate initiation of necessary investigation and management actions to identify, mitigate and remediate the cause of the accident. Initiate training and periodic testing/checking when necessary.

306. The probabilities of accident such as oil spills, accidental habitat destruction, water or air pollution, breach in cofferdam and hit with unexpected high flow are very low. However, such accidents can occur and overall environmental emergency response method may be used:

- Obtain an early warning of the emergency conditions so as to avoid adverse impacts on the environment
- Safeguard personnel to prevent injuries or loss of life
- Minimize the impact of such event on the environment by mitigating the potential for escalation and containing of the hazards
- Site in charge should have permanent mode of contact (e.g. mobile phone or walki talki) with the HSE officer.
- Contact name and number of HSE officer should be available in site office and displayed on site office notice board.

307. It is the responsibility of the Contractor to provide at least one First Aider during working hours on site to handle emergency conditions and accidents. The Contractor will ensure the availability of MBBS doctor, paramedic staff and an Ambulance on full time basis at the Contractor's camp. The Contractor will also get a hospital on panel for critically injured persons. The First Aid provider at working area will perform the following duties.

- Keeping all necessary first aid medicines and bandages in the first aid box at every time
- Replace the medicines before their expiry dates to avoid any health hazard to the people
- Provide first aid to the injured in the event of accident
- Report any accident / incident to the environmental manager immediately for necessary action
- Call ambulance in case of any serious emergency

308. Emergency siren should be installed at the barrage to inform the site worker about any emergency situation. The operation of the siren will be controlled by the HSE officer or his nominated person. The designate assembly area also should be marked and informed to site worker.

309. An outline of a contingency plan for the accidental spill is shown in Exhibit –4.

Exhibit-4 Accidental Spill Contingency Plan

Step	Diesel spill	Chemical and Oil Spill
Alert / Mobilize (by work supervisor)	-Alert emergency coordinator and team	-Alert emergency coordinator and team
Initial action (by HSE Officer)	-Start log of event -Determine appropriate strategy -Notify PMO in Lahore -Notify relevant authority	-Start log of event -Determine appropriate strategy -Notify PMO in Lahore -Notify relevant authority
On-going actions (Site Incharge)	-If there is a containment breach, use earth moving equipment to construct ditch or berm to contain spill. Use pump / absorbent to recover the product. Handle the recovered product according to the COSHH sheets	-If there is a containment breach, use earth moving equipment to construct ditch or berm to contain spill. If it contaminates the river use pump / absorbent pad to recover the product. Handle the recovered product according to the COSHH sheets
Stand Down (Site Incharge / The Engineer)	-Once the incident has ended the emergency team and authorities will commence a full investigation	-Once the incident has ended the emergency team and authorities will commence as full investigation
Waste disposal (Contractor)	-Collect all contaminated soil or absorbing pads and incinerate or treat with bioremediation at a controlled access area. In case of contaminated water the water should be treated and rESUsed or pump it back in to the river	-Incinerate or treat with bioremediation the collected product at a controlled – access area at the burn pit. Collect all contaminated soil and incinerate it at the burn pit

7.12 HEALTH, SAFETY & ENVIRONMENT (HSE) PLAN

310. It is the Contractor's obligations to provide and implement the Health, Safety & Environment (HSE) Plan. The purpose of this HSE Plan is to identify the potential impacts and to develop a mechanism for a better management of health, safety and environment (HSE) issues relating to the project. A detailed HSE Plan will be submitted by the Contractor to The Engineer/Client for approval.

Objectives: The HSE objectives include but are not limited to the following:

- To avoid all possible injuries during the execution of the project.
- To ensure all personnel employed on the Project are competent to carry out their designated safety tasks
- To develop positive health, safety and environmental protection attitude and perceptions at all levels of the project organization and create safety and environmental awareness in general
- Implement training programs that support the achievement of the Contractor's staff and personnel's competency in relation to health, safety and environment
- Complete the project without incurring any significant property damage to the adjacent permanent structures or temporary facilities
- Complete the project without causing unnecessary risks and damage to the surrounding environment
- Implement a hierarchy of communication forums that ensure that HSE concerns are raised and addressed at all levels of the organization
- Introduce methodology of motivating "good" safety and environmental performance
- Continuous monitoring and improve HSE performance

Site HSE Rules: The following HSE rules must be strictly followed:

- HSE orientation sessions before starting work
- Wearing of personal protective equipment
- Follow the message and instructions displayed on HSE notice boards at site
- Be aware of emergency assembly points and escape routes
- Promptly report all accidents to the concerned authority
- Maintain appropriate barricades as required
- Never temper with electrical cables and appliances
- The construction site should be designated as "NO SMOKING" area
- Vehicles must be driven at designated routes and drivers must have driving license for the class of vehicle they are operating
- Vehicles shall only be parked in designed parking areas

Emergency Response Plan: The purpose of this plan is to describe responsibilities in preparation for response to and recovery from and reasonably foreseeable incident.

311. In the event of any emergency the In-charge Site HSE/Environment Manager or a member of the HSE team shall take the following actions:

- Shall attend site of incident; assess the situation and issue directions to the concerned parties and to the Fire Fighting Team in case of fire

- Ensure that message about the incident have been communicated to Site Manager / Environment Manager of the Contractor
- Evaluate the scale of the incident and decide whether additional resources are required to deal with it adequately
- Liaise with site supervision staff for withdrawing any working permits
- Liaise with site supervision staff for the mobilization of any plants and equipment necessary for dealing with the emergency
- Limit access to the area with barriers, or other means to prevent unauthorized access
- Co-ordinate the re-instatement measures following stabilization of incident
- Maintain the records of the incident/ accident and prepare a full report of the event
- Take prompt and appropriate actions for defined events such as serious illness/injury, fatality, and snake bite etc.

Health, Safety and Hygiene: The measures should include:

- Initial medical examination of all employees of the Contractor to verify their fitness for work
- Provide a group insurance cover to the workers and labor on site or in the camp, against accidents, mishaps or loss of life on duty
- Monthly talks on occupational health
- Provision of qualified medical personnel and adequate medical facilities to the staff
- First Aid trainings
- Provision of hygienic food to the employees
- Provision of drainage, sewerage and septic tanks in office buildings and camp areas
- Good housekeeping practices should be ensured at camp sites, construction sites and batching plant site

Security: Security measures should include:

- Provision of Identity Card to the employees
- Regular attendance and a controlled time keeping of all employees
- Proper checking of visitors
- Restriction of un-authorized persons to the residential and work areas
- Restriction of carrying weapons and control hunting by employees
- Provision of boundary walls / fences with proper exits to office and residential areas

7.13 TREE PLANTATION PLAN

312. The Tree Plantation Plan will be prepared and implemented by the Contractor and verified by The Engineer. Strengthening of embankments and construction of additional depressed bays may require tree cutting. To mitigate this environment loss the only way out is the re-plantation with at least forty three hundred new trees along spill channel, guide banks and dividing island. Five new plants will be planted and protected for every one tree uprooted on site as there is ample land available for new plantation in the vicinity of the project area. New plantation should be undertaken near the area cleared for vegetation for project execution. List of trees that needs to be uprooted is provided in Appendix 7.3.

7.14 BORROW AREAS RESTORATION

313. It is necessary to utilize excavated material generated from construction of bypass gated as fill material. If during construction further material is required or contractor need to borrow material from any other site then the contractor can acquire private land through lease agreement with the land owner. Photographs record will be kept before and after the land use as borrow area.

314. Depressions and pits should not be left unfilled/open such that these are unusable and can be filled with rain water providing breeding place for mosquitoes or cause any health and safety issues.

315. Agriculture land should be restored such that it can be used for the agricultural purpose. The restoration of agricultural land includes but not limited to the following steps:

- Remove 6 inches of the topsoil and store it separately separate on site for its re-spread back on the levelled borrow area
- Excavate up to a maximum depth of 3 feet
- Level slopes as far as possible
- Restore the site to its original state or as per the satisfaction of the land owner

7.15 LAND ACQUISITION PROCEDURE

- Land Acquisition Act (LAA) 1894 is the primary law governing land acquisition in Pakistan. The rules and regulation of above law will be followed for the acquisition of private land
- It is envisaged that no private land acquisition will be required for the project implementation and contractor's facilities set up. However, temporary acquisition of private land may be required for borrow material. If the contractor proposes different locations of labour camp, batching plant etc. and requires any private land then he/she need to follow the LAA 1894 to compensate the land owner
- Land valuation will be carried out with the help of district officer and agree with the private land owner
- Cut of date will be announced at the day of compensation value agreed and signed with land owner and authorities
- The compensation will be paid to the affectee(s) prior to possession of the land being taken over by the Government of Punjab

7.16 RISK MANAGEMENT PLAN

316. The outline of the Risk Management Plan is provided in this section. The detailed and more precise plan should be prepared and implemented by the Contractor's Project Manager. The following Plan in Exhibit 5 identifies the possible hazards associated with the project activities, consequences of the occurrence, probability of the occurrence and action to reduce the risk to acceptable level i.e. low to medium.

Exhibit-5 Risk Management Plan

Hazards	Consequences of Occurrence (Severity-L,M,H)	Probability of Occurrence (L, M, H)	Risk (L, M, H)	Action to Manage the Risk	Residual Risk
Oil, Chemical Spills	Contaminate land and control water bodies (M)	H	H	-Select the location of material storage yard away from the water bodies -Store material on bunded area with impermeable layer -Good housekeeping -Loading and unloading of material should be manage by a competent person -Spill kit should be available to deal with small spills	L
Breach in Cofferdam	Fatality or serious injury of the worker Adverse impact on aquatic life (H)	M	H	-The construction and maintenance of cofferdam should be managed by a competent person -Findings of daily inspection should be recorded and analyzed -Sand bags should be available on site to deal with small damages in the cofferdam -Monitor river quality at downstream of the cofferdam on regular basis	L
Adverse Environmental Impacts on Barrage Pond Area due to Construction Activities	Deteriorate natural habitat of pond area (L)	H	M	-Implementation of the control measures to mitigate impact on biological resources -Select appropriate plant and equipment and enforce the speed limit for site traffic to minimize the noise and dust pollution	L

Hazards	Consequences of Occurrence (Severity- L,M,H)	Probability of Occurrence (L, M, H)	Risk (L, M, H)	Action to Manage the Risk	Residual Risk
Failure in Plant & Equipment e.g. lifting gears etc.	Fatality or serious injury (H)	M	H	-Inspect all the equipment including lifting chains and ropes at the start of the work -A competent person should manage the work on site	L
Extended Canal Closure	Damage the crop within the canal command area (H)	L	M	- Abbasia and Abbasia Link Canals are perennial canals and close only for canal cleaning work. All the work requiring canal closure should be arranged during available canal closure time. If required, use cofferdam or construct temporary bypass arrangement to continue canal water supply as per routine	L
Batching Plant	Deteriorate ambient air quality (M)	H	H	-Select batching plant location away from the living area or construct zero emission plant -Should not operate outside working hours i.e. night time or early morning -All the workers working at the plant should wear proper PPEs (breathing masks, gloves, eye protection etc.)	L
Smoke from Burning	Cause suffocation and diseases of respiratory tract (H)	M	H	-Provide smoke free fuel at labor camp -Cutting and burning of trees shall be prohibited	L

Hazards	Consequences of Occurrence (Severity- L,M,H)	Probability of Occurrence (L, M, H)	Risk (L, M, H)	Action to Manage the Risk	Residual Risk
Road Accidents due to Construction Work Activities	Casualty, serious injury, damage to infrastructure (H)	M	H	-Prepare and implement Traffic Management Plan as suggested in IEE	L
Adverse Social Impacts due to Migrating Labour from Other Parts of the Country	Extra burden on existing welfare facilities. Can Cause communicable diseases (H)	M	H	-Improve and increase the capacity of available existing services to cope with the requirement of additional users -Run a campaign within the labour camp and local community to make people aware of the cause, mode of transmission and consequences of communicable diseases e.g. HIV/AIDS, tuberculosis, typhoid, cholera etc.	L

L: Low; M: Medium; H: High

7.17 ENVIRONMENTAL MANAGEMENT COST

317. The cost provided in this section is based on the information available at up-dating feasibility level, which may be amended at detail design stage.

7.17.1 Environmental Monitoring Cost

318. Project's effects on the environment shall be monitored as described below:

i. For Construction Phase

Surface Water Monitoring

319. River water should be tested on quarterly basis at the barrage during barrage structure repair, motorization for gate operating system and bela excavation activities. The samples should be tested for all the parameters of NEQS (inland waters) and FAO guidelines (for irrigation, livestock and poultry). Dissolve Oxygen, pH and Electrical Conductivity (EC) of the river water should be monitored on monthly basis during construction phase. 2 numbers of sampling sites are identified for surface water quality monitoring on the basis of the proposed scope of work. Samples should be collected from upstream and downstream of the barrage during the construction phase.

320. The approximate cost of monitoring of river water quality, assuming 3 years of construction phase is PKR 1.35 million. The location and frequency of proposed sampling sites is described in table 1.

Groundwater Monitoring

321. Groundwater should be tested at quarterly basis. Testing is also required at the start of the project before using the groundwater as a source of water supply. The samples should be collected from all the sources of groundwater used by the contractor onsite i.e. hand pumps, tubewell etc. The parameters need to be tested include NEQS (for drinking water quality) and FAO guidelines (for irrigation, livestock and poultry). The approximate cost of monitoring the groundwater over 3 years of construction phase at quarterly basis is PKR 0.6 million. The details of location and frequency of proposed sampling sites is given in table 1.

Ambient Air Quality & Noise Monitoring

322. Ambient Air quality shall be monitored on quarterly basis by an authorized laboratory. Visual monitoring of dust pollution will be conducted at when required basis (during the project activities likely to generate dust pollution). The parameters for ambient air quality monitoring include carbon monoxide, NO_x, SO_x and particulate matter. The approximate cost of Ambient Air Monitoring over 3 years of construction phase is PKR 1.416 million.

323. Noise shall be monitored 3 times on each working day at every noise producing activity. The contractor shall purchase noise meters to undertake noise monitoring during construction phase of the project. The estimated cost for noise monitoring is PKR 0.05 million.

324. The approximate cost of physical environmental monitoring during construction phase is estimated to be PKR 3.416 million.

Biological Environment Monitoring

325. The impacts on biological environment due to project implementation shall be monitored on biannual basis during construction phase of the project. The monitoring shall be carried out by a qualified and experienced ecologist. The estimated cost allocated for this item is PKR 2.4 million.

ii. For Operational Phase

Surface Water Monitoring

326. River water should be tested once in pre and post monsoon season at the upstream and downstream of the barrage and at the same locations where design and construction phase monitoring was done. The samples should be tested for all the parameters NEQS (inland waters) and FAO guidelines (for irrigation, livestock and poultry). The approximate cost of monitoring of river water quality, for first 2 years of operational phase is PKR 0.4 million.

Groundwater Monitoring

327. Groundwater should be tested once in pre and post monsoon season at water sources used for construction purposes, dug wells within 1 km from wastewater mud ponds (if any) and at the same location where construction-phase monitoring was done. The parameters need to be tested include NEQS for drinking water quality and FAO guidelines (for irrigation, livestock and poultry). The approximate cost of monitoring the groundwater over first 2 years of operational phase is PKR 0.4 million.

328. The approximate cost of the monitoring of the physical environmental parameters during operational phase is PKR 0.8 million.

329. The required environmental monitoring details are summarized below in Table 7.1.

Table 7-1 Environmental Monitoring Plan for the Construction and Operational Phase

Sr. #	Description	Monitoring Location	Monitoring Parameters	Frequency of Measurement	Responsibility
Construction Phase					
A. Physical Monitoring					
1.	Ambient air quality	At Barrage Batching plant site Labor camp site	NOx, SOx, CO and Particulate matter (PM_{10})	Quarterly	Contractor
2.	Quantity and quality of groundwater used for domestic purposes	Camp site 1 km away from the camp site	Full suite of contaminants provided in NEQS (for drinking water) and FAO guidelines for irrigation, livestock and poultry Water table depth, discharge, physical-chemical parameters, biological contamination, heavy metals and toxic organic compounds	Quarterly	Contractor
3.	Quality of surface water used for construction activities	At source of surface water used	DO, EC, pH and TDS	Monthly	Contractor
			Full suite of contaminants given in main report of EIA (in Ch. # 4)	Quarterly	Contractor
4.	Emission of dust from the construction activities	Construction sites Campsite Access roads Borrow areas	Visual Observations	Throughout construction phase	Contractor
5.	Visual check for exhaust emissions from the vehicles	Construction sites Campsite Access roads Borrow areas	Visible Checks	During routine monitoring	Contractor
6.	Noise	Construction site Camp site Access roads Communities within 500 m of construction site	Noise measurement	Once a week throughout the construction phase	Contractor

Sr. #	Description	Monitoring Location	Monitoring Parameters	Frequency of Measurement	Responsibility
7.	Soil erosion	Construction site Campsite Access roads Borrow area	Visual observations for sheet or rill/gully erosion	During routine monitoring of entire project activities especially after rains	Contractor
8.	Resource utilization	Project site	Quantity of material used including water and fuel	Daily during construction phase	Contractor
9.	Solid Waste Generation	On camp site and Construction site	Any sign of soil or water contamination; any un-disposed waste	Daily during whole construction phase	Contractor
10.	Wastewater generation	Camp site, offices, colony and construction site	Wastewater generation rate, integrity and maintenance of the septic tanks and soaking pits, any sign of soil or water contamination	To be determined through water management techniques	Contractor
11.	Oil wastes /spills	Oil storage area, vehicle washing lines; any other spill area	Facilities to control the accidental oil spill as per oil spill contingency plan; any sign of soil or water contamination	Daily during construction phase	Contractor
12.	Monitoring of water flows in the Rivers and Canals	Panjnad Barrage and various location in the Canals	Water flows. Also vigilance on any water thefts in particular during low flow periods	Throughout the construction period	Contractor
13.	Monitoring of cumulative impacts	All project sites,	All environmental and social parameters such as soil erosion, soil/water contamination, noise, air contamination, vehicular traffic, local resource utilization, and other impacts on communities	Throughout the construction period	Contractor
B. **Biological Monitoring**					
14.	Visual check for vegetation loss	Construction sites Campsite Access roads Borrow areas	Type and number of tree species uprooted	At the beginning of construction activities and at biannual basis	Contractor
15.	Visual check for fauna loss	Construction site Camp site Access roads Borrow area	Mammals, Reptiles and Amphibians, Fish, Birds Illegal hunting, poaching, killing of mammals and reptiles (river) and water birds	At the beginning of construction activities and at biannual basis	Contractor
C. **Socio-Economic Monitoring**					

Sr. #	Description	Monitoring Location	Monitoring Parameters	Frequency of Measurement	Responsibility
16.	Socioeconomic issues	At project locations; settlements	Local people recruited for all manual labor and other jobs for which local skill are available; grievances of and conflicts with communities	During construction phase	Contractor
17.	Cultural invasion	Entire project area	Community resistance to Contractor's attitude, outside labor Cultural clashes with outside labor (not observing sanctity of the holy month of Ramadan, prayer timings and local customs and traditions etc.)	Construction period	Contractor
18.	Dispute between outside and local labor force for job hunting	Entire project area	Social disturbance because of dissatisfaction with employing outsiders	Construction period	Contractor
Operation Phase					
1.	Restoration	At all project locations (construction sites, camp sites, offices, tracks and others)	Restoration and rehabilitation as per Restoration Plan	At the end of the construction phase	Environment unit (EU) of PMO
2.	Surface Water quantity and Quality	Upstream and downstream of the Barrage, at the same locations where design- and construction-phase monitoring was done	Flows, pH, conductivity, TSS, TDS, BOD and COD	Once in pre and post monsoon season for 2 years. Flows on a regular basis	Environment unit (EU) of PMO
3.	Groundwater Quality	Water sources used for construction purposes and dug wells within 1 km from wastewater mud ponds (if any). At the same location where construction-phase monitoring was done	Physical- chemical parameters, heavy metals and toxic organic compounds	Once in pre and post monsoon season for 2 years	Environment unit (EU) of PMO
4.	Soil Erosion	At project sites and along the aligned borrow areas; at locations prone to soil erosion	Visual Observations	After site restoration	Environment unit (EU) of PMO
5.	Habitat Disturbance	Within the project boundaries	Visual Observation	At the end of the construction phase	Environment unit (EU) of PMO
6.	Compensatory tree plantation	According to the tree plantation plan	Survival rate of tree saplings	Once/twice in a year for three years	Environment unit (EU) of PMO

7.17.2 Environmental Audit Cost

330. Environmental Audit should be carried out on annual basis and at the completion of the project by an independent consultant. The approximate cost of this item is PKR 1.5 million (on the basis of three years of construction phase of the project).

7.17.3 Training Cost

331. Training is considered to be an important part of environment awareness and all site management and work supervisors should undertake periodic training. The Contractor will arrange to run a proper campaign among the workers to make people aware of the causes, mode of transmission and consequences of HIV/AIDS. Contractor will arrange briefings to all workers regarding the biological resources and wetland area. It should be clarified to the workers that unnecessary and out of bound activities / movements are strictly prohibited in the barrage pond area. All forest and fisheries laws should be explained to the workers.

332. Ten training sessions are proposed for the project staff in this respect. The details are included in the EMP under Training Plan. The estimated total Training cost comes out to be PKR 0.5 million.

7.17.4 Plantation / Environmental Improvement Cost

333. Constructing four new bays at existing junction groyne will involve uprooting of trees. Strengthening of embankments and construction of additional depressed bays may require tree cutting. Five new plants will be planted and protected for every one tree uprooted on site as there is ample land available for new plantation in the vicinity of the project area. New plantation should be undertaken near the area cleared for vegetation for project execution. The scope of work includes plantation of woody, fruit and flower plants. The approximate cost of this item is estimated to be PKR 0.1 million.

7.17.5 Cost of Implementation of Emergency Plan

334. The emergency plan will be prepared and presented in the EMP. The plan will be prepared to address emergency conditions likely to occur in result of unexpected flood, breach in cofferdam or accidental spill of oil or chemical. The approximate cost to deal with such unforeseen incidents and accidents during construction phase is estimated to be PKR 0.5 million.

7.17.6 Special Waste Disposal Cost

335. The approximate daily production of domestic waste at labor camp is estimated to be approximately 500kg (1/2 kg per person per day). The cost for disposal of domestic waste for 3 years of construction phase including the preparation and maintenance of the temporary storage area at the site is included in the contractor's contractual obligations.

336. The cost allocated in this section shall be utilized for special waste disposal. Specialized contractor should be hired to dispose of the special waste i.e., packing waste, empty containers, cement bags, clinical waste, electric batteries etc. The approximate cost of the disposal of special waste is PKR 0.5 million.

7.17.7 Cost of Drinking Water & Groundwater Monitoring near Disposal Pit

337. It will be one of Contractor's contractual obligations to arrange the supply of running drinking water at appropriate pressure to the site workers. The access of the drinking water should be available to every site worker. The cost of this item is included in the contractor's contractual obligations. Water samples should be collected and tested on quarterly basis to confirm its suitability for drinking purpose. The approximate cost of tap water testing is PKR 0.25 million.

338. It is proposed to treat the domestic wastewater generated from the labor camp, which should be collected with provision of underground sewerage system, temporary storage at septic tank and disposal in filter bed soaking pit. The cost of this item is included in the contractor's contractual obligations.

339. A groundwater sample from the nearest source of groundwater from soaking pit i.e. tube well, hand pump, open well etc. will be collected and tested on quarterly basis by the contractor in order to ensure that the wastewater disposal does not adversely affect the groundwater quality. The sample should be collected from the downstream of soaking pit in the envisaged flow direction of groundwater. The allocated cost for this testing is PKR 0.25 million.

7.17.8 Site Visits by Regulatory Authorities

340. Inspections by stakeholder and concern bodies for example WWF, Wildlife, Forest or Fishery officers etc. should be facilitated at site. The approximate cost of this item is PKR 0.5 million.

7.17.9 Traffic Management Cost

341. The Traffic Management Plan will be prepared by the contractor to manage the site traffic and public traffic during construction phase of the project to minimize the interruption in the flow of regular traffic. The approximate cost estimated for this item is PKR 1.5 million. The allocated amount will be required for the relocation of the toll plaza which includes construction of rest area (sitting area, kitchen, wash room etc.), localized road widening and the barrier, provision and installation of temporary traffic signals, safety sign boards and speed breakers as well as controlling dust pollution during the barrage repair work.

7.17.10 Public Park Development

342. On the basis of the Public & Stakeholder consultation development of a public park at Panjnad barrage is proposed. The state land available beside Panjnad Main Line Canal is found most suitable for development of the public park. Further details are included in EMP. This will raise the aesthetic value of the project area and will also provide for a recreation spot to the local population. The estimated cost allocated for this item is PKR 20.0 million.

7.17.11 Restoration Cost

343. The area being under the use of contractor during construction phase should be restored at the completion of the project to the original level without any additional cost by the contractor.

344. The total cost estimated for the implementation of the environmental management plan is summarized in Table 7.2.

Table 7-2 Environmental Management Cost

Activity	Cost (PKR Million)
Environment Monitoring Cost	6.616
Environmental Audit Cost	1.5
Training Cost	0.5
Cost of Implementation Emergency Plan	0.5
Special Waste Disposal Cost	0.5
Cost of Drinking Water & Groundwater Monitoring near Disposal Pit	0.5
Plantation Cost	0.1
Site Visits by Regulatory Authorities	0.5
Traffic Management Cost	1.5
Public Park Development Cost	20.0
Total	**32.216**

The above cost will be covered for the project (as part of the loan money).

7.18 CONTRACTOR'S OBLIGATION

345. The contactor will carry out the following obligations:

- **Disposal of waste construction material**

346. The Contractor shall in consultation and approval with the Supervising Consultant select and abide by the selection, a site for disposal of waste construction material as well as the material used for construction of coffer dam. Contravention to this clause may tantamount to contravention to contract and the Contractor will be responsible of removing the material dumped on a wrong site, at his own expense as early as possible. In case of delay, the contractor will pay a fine, suggested by the supervision consultant, for his negligence.

- **Adjustment with unstable locations appearing during construction especially the foundation**

347. In case an unstable location appears during construction, especially the foundation, the contractor shall immediately inform the Supervision Consultant expressly providing full technical details about the problem. The Supervision Consultant will inspect the site; preferably the same day the report is received and will, if necessary, agree to make modifications and changes in the design to stabilize the situation such as change in the depth of foundation. Contractor will not make any changes in the specification without express approval of Supervision Consultant. Contravention to this provision will mean unauthorized construction carried out for which RE will issue dismantling orders.

- **Location of labour camps, material dumps / depots, equipment and machinery yards, approach roads and routes**

348. Irrigation and Power Department land is available for location of Labour Camps, Material Depots, Equipment and Machinery Yard, link roads or other activities related to these matters and proposed sites have been shown in fig. 2. The Contractor will choose particular sites within the overall campus with the consultation with Supervision Consultant and PMO. If the Contractor chooses to locate his facilities on a private land, he will himself be responsible for any compensation, resettlement or rehabilitation process and costs and Supervision Consultant or Irrigation and Power Department shall not be involved in acquiring or using the land in making any payments for doing so. If the contractor selects different location for the Batching Plant, Labour Camp, borrow area etc. then the contractor will develop base line data for the new location on his own cost and resources.

- **Rehabilitation of construction and extraction sites**

349. The Contractor shall carry out construction work exactly on the same site and according to the same design as provided in the Tender Documents. Also the camps site, the material depot, the machinery and equipment yard, link roads, borrow areas and coffer dam shall, after the completion of construction, be restored and rehabilitated and brought to at least the same condition, in which these were handed over to the contract. A set of Photographs and a video tape film shall be prepared to show the pre-construction sites and post construction rehabilitated sites.

- **Drainage, paths, roads, linear fixtures crossed/damaged by machinery moving to and from the construction sites**

350. During the construction, if the Contractor's vehicles moving to and from the construction site(s) cause any damage or disruption of services pertaining to drainage systems, paths, roads linear fixtures e.g., transmission lines and fences, the Contractor shall get the damage repaired and services restored within the shortest possible time of the damage, failing which the Supervision Consultant will get an assessment of the damage and losses and debit that amount to Contractors account and the next payment shall be made to Contractor after deducting the debited amount.

- **Earthen embankments or concrete work vicinity scouring on the protection bunds or on the main sill structure**

351. All such spots where there is a possibility of scouring of earthen embankments or concrete work edge the Contractor shall protect by provision of protection walls or stone rip-rap work, failing which the payment of the Contractor shall be with-held

- **Discharge spill or dumping on any building, house, graveyard, archaeological site (established or newly found), unstable slopes, un-compacted embankment or leaking into construction area**

352. The Contractor shall be contractually bound to not to allow or cause discharge spill or dumping on any building house, graveyard, archaeological site (established or newly found), unstable slopes, un-compacted embankment or leakage of material/waste into the construction area. Any such failure shall be duly noted by Supervision Consultant during site inspections and contractor shall immediately remedy the situation failing which the payment of the contractor shall be with-held and the damage so caused shall be debited to contractor's account under the contractual provisions.

- **Diesel and other fluids spilling over to River water from construction machinery**

353. The Contractor shall ensure that his construction machinery is always in first class working order and no spilling of Diesel or any other fluids into the River, is caused by the defective machinery of the Contractor. For any such spill the Contractor shall pay the environmental compensation to be assessed by Supervision Consultant and the said amount shall be debited towards the payment of the Contractor.

- **Protection of construction work from floods**

354. The Contractor shall, throughout the construction work, manage to keep an eye on the flood position of the barrage and shall remain in touch with Flood Control Centre and remain equipped with means and equipment for taking protective measures to protect the works under construction. Irrigation and Power Department shall not be responsible for any damage caused by floods and any works washed away shall be reconstructed by the Contractor at his own cost within the tenure of the contract.

- **Providing proper diversion of water from downstream**

355. The Contractor shall, in consultation with Supervision Consultant provide proper diversion to water flowing downstream and by requesting the Barrage Management opening and closing the main barrage gates and by collaboration with local communities especially the Fishermen community as per SFA and preparing them for any such diversions or closures. Losses caused to construction work due poor or mismanaged river flow diversion shall be considered as negligence on the part of contractor any damages or losses caused due to this negligence shall be borne by the contractor.

- **Control on air quality by not allowing Machinery to cause dust, smoke or noise pollution**

356. The Contractor shall not cause deterioration of air quality by using old or ill maintained machinery which raise excessive dust, produce excessive smoke or cause excessive noise pollution. The Contractor shall follow strict standards of maintenance of machinery; provide qualified and trained drivers and operations for the vehicles. The Contractor shall also sprinkle water on kacha roads to be used as link roads, and sites where the earth is to be dumped. The Contractor shall provide protective masks to his work force. Failure to do so shall be taken as serious contravention of the contract and shall cause the payment to be deferred till the correction of the situation.

- **Control of dust or other pollutants from Stored materials, material depots or spoil heaps**

357. The Contractor shall:

(a) Locate his material depots and spoil dump as far away from the villages/community “Deras” as possible.
(b) Keep all such materials covered for effective control of the fugitive dust.

358. Failing to do the Contractor will bear the cost which may have to be incurred on arranging remedy to defaults.

- **Use of outdated machinery**

359. The Contractor shall obtain a certificate from Vehicle Examiner working under the Supervision Consultant but paid by the Contractor, that all the machinery employed is either new or in first class fitness condition so as not to cause smoke or oil leakages. Supervision Consultant will not allow the use of any outdated machinery.

- **Protection of the Biological Resources**

360. The Contract shall ensure that:

a) Unnecessary and out of bound activities/movements are not done outside the campus allotted to him for setting-up the labour camp, material depots and machinery yard etc.
b) No fire arms are carried by any of the employees or labour.
c) All Forest, Wildlife and Fisheries Laws are fully respected and abided by the Contractor and his work force.
d) The Biodiversity is respected and saved on its terrestrial, aquatic and aerial habitats.
e) Necessary sign boards indicating boundaries of the barrage pond area are displayed to make labour, visitors and members of public to remind them of their obligations towards Biota.
f) Inspections by Wildlife, Forest and Fisheries Officers are facilitated in camps to facilitate a proper implementation of relevant Laws.
g) Communities are given awareness and are involved in proper protection of the Biota inside and around the Project site.

- **Respect for socio-economic and cultural values and heritage**

361. The Contractor shall be bound to:

(a) Ensure that no damage or disruption is caused to the social infrastructure or public services being provided to the people e.g., education, health, electricity supply, drinking water supply facilities for public gathering or religious congregations.
(b) Ensure the Contractor or his employees remain above the local Tribal tensions especially the disputes over distribution of canal water and use of aquatic life.
(c) Ensure that existing ownership of land around the Project is respected.
(d) Ensure that if some construction material has to be procured from or through a member of local community, it must be by a proper Social Framework Agreement signed by all the parties.
e) Ensure that no damage or adverse effect is caused to archaeological sites (in case find on site) graveyards and burial places.

- **Public safety, health and safety at construct site, including measures against HIV/AIDS and life insurance**

362. The Contractor shall:

a) Put up temporary but prominent sign boards in all of the project activity area warning people against likely hazards which can be caused due to certain activities. (Also to be reflected in SFA).
b) Arrange to run a proper campaign in the labour camp, to make people aware of the causes, mode of transmission and consequences of HIV/AIDS.
c) Strengthen the existing Basic Health Unit (BHU) for the benefit of the labour as well as the surrounding villages.

d) Ensure proper cleanliness and hygienic conditions at labour camps by ensuring a clean mess, proper drainage and suitable disposal of solid waste. Inoculation against Cholera will be arranged at intervals as recommended by Health Department.
e) Keep all the camps, offices, material depots, machinery yards and work site open for the inspection of health and safety measures, and related documents and include in the contract document the text regarding accessibility to the camps etc.
f) Provide proper overall, helmet and field boots and earplugs to work as a precaution against any mishap, and interlink various parts of the construction complex with local wireless telephones also fitted the vehicles.
g) Provide a group insurance cover to the workers and labour on site or in the camp, against accidents, mishaps or loss of life on duty.

- **Employment of locals in the construction work**

363. The Contractor as an obligation of the Contract will employ, subject to availability and work ability, maximum number of local labour for construction work.

- **Impact due to material and waste left behind when construction or dismantling Cofferdam(s)**

364. A careful planning of construction and dismantling is the Contractor's contractual obligation. It is his further obligation to remove all left over material and construction waste. The contractor shall ensure that turbidity / dissolved oxygen will not exceed from the acceptable levels during construction or dismantling of cofferdam(s). Contractor will consult with the environmentalist from the supervising consultant to get approval of the process of constructing / dismantling of cofferdam(s). It is also obligation of the contractor to remove at least 70% of the cofferdam construction. Furthermore, all removable sheet piles, if any, will be completely removed or at least underwater cut at river bed level after completing the construction activities. Failure to complete the task will liable the contractor to deduct total cost of the sheet pile left, as well as the cost of the construction of cofferdam left behind lesser than 70%. Disposal site(s) for the dismantled cofferdam(s) will be finalized by RE and ESU.

7.19 CONCLUSION

365. The potential impacts of the project are associated with only the construction phase of the project and all of these impacts are temporary and reversible in nature. These impacts can be mitigated through the proper implementation of the EMP. Therefore it is concluded that the project is environmentally friendly, financially viable, economically sustainable, gender neutral and pro-poverty alleviation.

8. PUBLIC CONSULTATION

8.1 GENERAL

366. Timely and broad-based stakeholder involvement is an essential element for an effective environmental assessment, as it is linked with Project Planning, appraisal and development in general. Public involvement during Initial Environmental Examination (IEE) has a tendency to improve project design environmental soundness and social acceptability.

367. On the contrary, IEEs that fail to be inclusive lean to have less influence over planning and implementation and resulted in high environmental and social cost. Considering more stakeholder involvement in IEE process resulted in improving the quality of the environmental assessment (EA). This is due to the prediction of the impacts using impact assessment often requires many years information and good quality base line data. Environmental Assessment that involves broad-base stakeholder consultation has greater potential to assess wider information resource-base and generation of accumulating knowledge of the local environment.

8.2 LEGAL REQUIREMENT FOR PUBLIC CONSULTATION

368. According to the IEE/EIA Review Regulations 2000 and ADB Environment Policy public consultation is mandatory for environmental assessment study.

8.3 HOW THESE COMMENTS WERE ADDRESSED; CONSULTATION METHODOLOGY

8.3.1 Stakeholder Identification

369. They are grouped into the following main categories

i. Local Communities
ii. Government & Local Government Bodies
iii. Civil Societies
iv. Private Sector Bodies
v. Migrants

370. The groups or institutions identified as stakeholder under each category are listed below;

I. Local Communities
   a) Local labor (landless)
   b) Farmers of all land holding categories
   c) Fishing communities
   d) Female-head household
   e) Small business owner

II. Government

There can be many departments who can be indirectly related to the project but those who have high relevance include;

   a) Punjab Irrigation Department (including both top and low ranked officers and staff)

b) Punjab Forest Department, Wildlife, Fisheries Department
c) EPA- Punjab

III. Civil Society Institution that may have relevance to the Project includes various NGO's working in the construction and social development
IV. Private sector bodies can be commercial e.g. plantation manager, fishing contractors etc.

8.3.2 Consultation Process and Technology

371. Public Consultation has been conducted in two phase once during the early stage, reconnaissance survey and once during the preparation of IEE. Consultation with stakeholder will also be carried out throughout the Project cycle and by different member of the team at different stages of the study. Consultation process includes focus group discussion, village meetings and semi-structured interviews and one to one meeting or interviewed in the case of government, private and civil society institutions. During the consultation process, the stakeholders were briefed about the project objectives and scope. Their fears and suggestions were recorded. Women consultations was undertaken, under Gender analysis and explained about the benefits of the project.

372. All meetings and discussion were held during day time on working days to ensure the availability and participation of the group/individual being consultant. The consultation is sensitive to the local language and cultural needs and wherever expatriate staff is involved local interpreters will be used, as the staff observed local norms.

373. Local community and Wildlife and Fishery department located in Tehsil Ali Pur have been consulted under phase I public consultation and their point of view and information provided are included in this study. After finalization of the scope of work a community consultation was held in November 2013, and the community was informed that the project is now being finalized. In addition to these community and institutional consultations, a formal announced public hearing to experts, community members and civil society was also held, as required by the Punjab Environmental Protection Act 1997 and the Pakistan Environmental Protection Act 1997. The public hearing was held on 3rd February 2014 and environmental assessment was thereafter approved by the Punjab EPD.

8.4 OBJECTIVES ACHIEVED WITH THE PUBLIC CONSULTATION

1 Eliminate the scare that the canals will remain closed outside the routine closure period during the construction period. It was clarified that due measures will be taken that canals would run as per usual program and canal closure will take place only under the notified canal closure program as follow.

Name of Canal	Status of Canal	Periods when canal would close
Panjnad Canal	Non-Perennial	October to April
Abbasia Canal	Perennial	5-Jan to 31-Jan
Abbasia Link Canal	Perennial	5-Jan to 31-Jan

2 No change would ordinarily be made in existing capacity of canals during construction phase, so no impact is anticipated on the canal command area. It was explained that

project aimed at rehabilitating the Panjnad Barrage and increase the capacity of the barrage by provision of flood bypass channel at north-west end of the barrage, strengthening embankments, barrage structure and dredging the silt within the pond area of the barrage. The local community was informed about the surface water quality and the water quality of the existing tube well is not fit for drinking purpose without any treatment as identified in the baseline study.

3 Resettlement Plan (RP) will be prepared to facilitate the affectees and submitted to the authorities under different cover.

4 Eliminate the fears that the large number of workers and labor will be brought by the contractor from outside the project area and ensure them that an opportunity of employment generated by the project shall be availed by the people of the area.

5 It was clarified that no access roads or public paths damage or alter from the contractor(s) activities i.e. developing labor camp, material depot, machinery yard etc.

6 It has been ensured to the local community that maximum employment will be offered to the local labor/workers. They were given the following illustrative numbers of skilled and unskilled labor that will be required for the project.

Table 8-1 Employment Opportunity at Panjnad Barrage Rehabilitation and Upgrading Work

	Approximate No.	Minimum Percentage of Local
Skilled Worker	130	As much as possible
Semi-Skilled Labor	600	As much as possible
Unskilled Labor	1200	As much as possible

i. Fishermen of the community believe that the construction activities would not put adverse effects on fishing industry as most of the Project activities schedule within half kilometer of upstream and downstream of the barrage structure which is a prohibited area for fishing. However the strengthening of the embankments work will raise the noise level of the surrounding area and could affect the fishing activities next to the embankments.

ii. Question was passed by the community that presence of some 1930 male members of labor from general locality of project will not only restrict the chances of women employment, but also cause moral and social problems for the free movement of local women folk in the area. It was clarified that strict discipline would be exercised on the labor force by providing stringent clauses in the contract document. To cut out the possibility of any moral issues or Communicable diseases spread, a well-organized campaign shall be run.

iii. Road and kacha paths within the project areas would be exposed to the heavy traffic due to Project activities. This could raise the road accident and deterioration rate of the roads. It was clarified that due sinology and traffic management plan would be put into operation to minimize the impacts.

iv. With arrival of about 1930 additional persons, the price of accommodation in project area and Panjnad Barrage markets would go up, and price index would go unfriendly for

the local villagers. It was clarified that a Labor Camp will be constructed to accommodate for workers. It was also explained to the local community by some trade oriented people that instead of rise in price those would fall because larger market activities reduce the profit margin and price. More economical activities and better employment opportunities will be available for local community due to the rehabilitation of the barrage. This will help in lowering the poverty line in the area.

374. The following points came up in open acceptance of the project.

a) Greater employment opportunity was most welcome.
b) Greater economic activity will alleviate poverty.
c) Panjnad barrage will be saved and given longer base of life and thus the dependent agriculture.
d) Present level of services i.e. electricity, communication, schooling, water supply etc. is likely to improve.
e) Wildlife Public Parks will attract visitors and tourism in the area and put positive effects on the local economy.

Social Framework Agreement

375. This is a Draft Social Framework Agreement between an official representing the Punjab Irrigation Department (PID), Government of Punjab and the villagers' Committee, whose names have been inscribed below in their presence and full consent.

Sr. No. of Village	Village	Name (Two from each Village)	Father's Name
1.			1.
			2.
2.			1.
			2.
3.			1.
			2.
4.			1.
			2.
5.			1.
			2.
6.			1.
			2.
7.			1.
			2.

8.			1.
			2.
9.			1.
			2.

1. We the committee of village leaders/elders has agreed unanimously to nominate _____ S/O _____ as our Chairman and authorize him to enter into an SFA with PID on our behalf. We understand and pledge that this SFA will be a binding on us and PID throughout the currency of the construction work as well as the operational phase.

Form for Signature or Thumb Impression (TI) of the Chairman and the Members of the Villagers Committee.

Sr. No.	**Name**	**Signature/TI**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

2. By mutual consent it is agreed that Punjab Irrigation Department

   i. Shall not occupy any agriculture land or acquire any other land during the construction of the project.
   ii. Shall not cause any damage or reduction in the water supply in the canals during the construction period of the project, except in case of force majeure e.g. high floods, strong storms or any other act of God
   iii. Shall not cause any disturbance to the wildlife, wetland, archeological heritage or a place of worship
   iv. Shall not interfere in the social political or tribal balance of the area.
   v. Shall wherever possible, facilitate better services and supplies to the area e.g. schooling, health, awareness on epidemic and communicable diseases, electricity and road/rail communication.

3. Also, by mutual consent it is agreed that all the villagers residing in the area influencing project (name of the villages listed in para 1 above), collectively and severally:

   i. Shall not interfere in the location of labor camps, material depots, equipment yards and all the approach roads to be used during project construction phase, all of which will be located on the lands of Punjab Irrigation Department
   ii. Shall not interfere if the Punjab Irrigation Department decides to shift the construction of works elsewhere on a more suitable site as long as the activity remains on PID's own land
   iii. Shall not receive any discharge of water slurry or oil spills to any graveyard or archaeological site
   iv. Shall not cause any damage to wildlife or forest resources of any wildlife reserve and no villagers will be involved in killing, poaching or illegal hunting
   v. Shall not allow reduction or official interference in our existing services and facilities e.g. education, health, electricity, water supply, religious and social congregations
   vi. Agree that in case the contractor wishes to obtain some material from the private lands or wishes to make use of any piece of land outside the Punjab Irrigation Department land that would invoke a new agreement between the villagers and the contractor and PID or Govt. of the Punjab shall not be involved in that in any way
   Vii Agree to respect and observe the cautions on the sign boards displayed by project authorities and shall not remove or cause to be removed any signboards or installations put up by PID or their representatives

(Add more conditions if required as per the prevailing circumstances).

This SFA has been signed this _____ day of _____, at _____

Signature Resident Engineer (Full name and address)	Signature Chairman Villagers' Committee (Name and Address)

Counter signed

Signature

Designated Official of Irrigation Department, Punjab

(Full name and address)

8.5 GRIEVANCE REDRESS MECHANISM

376. This section describes mechanism (which will be notified after the approval of LARP) to receive and facilitate the resolution of Displaced Persons' (DPs) concerns and grievances. This explains the procedures and process of entering the complaints of DPs including women and accordingly their redressal mechanism. DPs will be fully informed of their rights and of the procedures for addressing complaints whether verbally or in writing during a continuous consultations process during the LARP as well as project implementation. It is preferred that DPs/ local community will need to enter their complaints/ concerns on a Grievance Redress Register (GRR) consisting the minimum information of "name and address of complainer (s), description of complaint (s), action taken, status of resolution of complaints and other necessary information/ record and also record the reasons if issue(s) remain un-settled.

377. However, all relevant efforts will be made to avoid/ or minimize the extent of grievances prior to treat under the redress process. This can be obtained through the practicable LAR design and implementation, by ensuring full participation and consultation with the DPs, and by establishing extensive communication and coordination program between the community, the PMO, the DO (Revenue)/ LAC and other concerned Departments.

378. To minimize the discomfort of the DPs, the GRC will be available at grass-root level to both DPs and local community. The GRC will be composed of following members:

GRC Composition

i). Concerned Executive Engineer/ DD (PID)	Convener
ii). DO (Revenue)/ LAC	Member
iii). DD (Resettlement)	Member
iv). DD (Social Mobilization)	Member
v). Representative of Displaced Persons Committee (DPC)	Member

379. The PIU will be responsible to inform the DPs/ local community about the process and procedures of GR mechanism by pasting the information at prominent places. The complaints will be registered by maintaining a Grievance Redress Register (GRR), where the name & address of complainer, date, description of complaint and action taken will be entered.

380. The payments relating to the land compensation will be made through the DO (R)/ LAC, while for other assets/ losses and allowances, the payment of compensation will be made directly from the PMO (PID).

381. Similarly, the issues/ community concerns relating to the land will be addressed through the Revenue department (LAC) and or can also be referred to GRC, while issues other than land will be directly redressed by the PIU at field level (District) and can also be placed with GRC. If issues are still unsettled, these will be forwarded to the PD (PMO) and finally to an appropriate court of law.

Grievance Redress Process

382. The process of grievance redress is discussed as below:

i). First, complaint resolution will be attempted at site (field level) by the PIU, DPs/ DPC, or informal committee;

ii). If the issue still unsettled, a grievance can then be lodged to the GRC who will have 14 days to decide the case/ issue.

iii). If no solution is reached, the grievance can be forwarded to the Project Director (PMO). DP (s) (must lodge the complaint within one month of lodging the original complaint with the GRC, and must produce documents supporting their claim. The PD (PMO) will provide the decision within 3 weeks after registering a complaint. The decision will be in compliance with the LARF provision as well.

iv). In case, the grievance redress system does not satisfy the DFs/ DPs, then they can pursue further by submitting their case to the appropriate court of law in accordance with the Section 18 to 22 of the LAA 1894.

Table 8-2 Public Consultation

Sr. No.	Meeting Place	Date	Participants	Main Concern	Replies
1.	At the Barrage	28.07.2010	Public Members Shopkeeper Altaf Hussain Shopkeeper M. Shahzad Shopkeeper M. Ajmal Shopkeeper M. Nawaz Shopkeeper Hashim Farooq PIAIP Consultants Environmental Specialist Ahsan Bela	The benefits from the project to the local community. Arriving of possibly 1000 labour from other part of the country may adversely impact the social life and the local women movement in the area.	Protection from flood, leakage of water through the gates will be minimize and so there will be more water in canals. Job opportunities to the local community. It was clarified that strict discipline would be exercised on the labour force to restrict the possibility of any moral issues or spread of communicable diseases.
2.	Forest Department Office at Tehsil Alipur	28.07.2010	Local Forest Department Office Section Officer Mehr M. Ashraf PIAIP Consultants Environmental Specialist Ahsan Bela	Wildlife habitat adversely impacted due to vegetation clearance during construction activities.	The idea of undertaking new plantation was appreciated which will enhance the biodiversity of the area. All fishing, wildlife and forest laws are fully respected and abide by the contractor and his work force.

Sr. No.	Meeting Place	Date	Participants	Main Concern	Replies
3.	Wildlife Department Office at Tehsil Alipur	29.07.2010	Local Wildlife Department Office Game Voucher M. Asad PIAIP Consultants Environmental Specialist Ahsan Bela	Wildlife habitat adversely impacted due to the construction activities.	It was explained that all the wildlife, forestry & fishery laws will be implemented on site to avoid adversely affecting the wildlife and flora of the area.
4.	Punjab Irrigation Department Office at the Panjnad Barrage	29.07.2010	Punjab Irrigation Department Executive Engineer Malik Faiz Rasool Sub Divisional Officer M. Imtiaz PIAIP Consultants Environmental Specialist Ahsan Bela	The concern was raised that the improvement is required in the existing infrastructure including Officer's Colony etc. The canal closure shall be avoided and significance of continuous routine water supply in all canals was highlighted.	It was ensured that all the activities that require canal closure will be carried out during annual canal closure period and if canal closure is required then alternate water supply will be arranged. The labour camp will be a permanent structure which will be handed over to other departments e.g. Irrigation Department.
5.	Head Office Meteorological Department at Lahore	04.04.2012	Meteorological Department Staff Coordinator Officer Syed Pervaiz Hussain PIAIP Consultants Environmental Specialist Ahsan Bela Junior Environmentalists: - Afaf Ayesha - Nosheen Aslam	Heavy rainfall during monsoon (July, August) cause flooding and dust storms occasionally hit during summer season.	It was informed that the emergency response and contingency plan will be prepared to handle emergency conditions (including flooding, dust storms, heat storks etc.)

Sr. No.	Meeting Place	Date	Participants	Main Concern	Replies
6.	Social and Environmental Management Unit (SEMU) at Lahore	06.05.2012	Social and Environmental Management Unit (SEMU) Deputy Director Shahid Habeeb PIAIP Consultants Environmental Specialist Ahsan Bela Junior Environmentalists: - Afaf Ayesha - Nosheen Aslam	Extra burden on existing services e.g. health facility, education, electricity etc. Project's heavy traffic may damage the roads and kacha paths of the area.	It was explained that due sinology and traffic management plan would be put into operation to minimize the disruption of traffic. Regular spraying of water would be undertaken to minimize the dust pollution.
7.	Director of Land Reclamation (DLR) at Lahore	11.05.2012	Director of Land Reclamation (DRL) Senior Research Officer M. Farooq PIAIP Consultants Environmental Specialist Ahsan Bela Junior Environmentalists: - Afaf Ayesha - Nosheen Aslam	Possible impact of water logging due to alteration in water level in result of project activities.	It was explained that there will be no change in pond water level, therefore inundation or water logging will not be the issue due to implementation of the project.
8.	SCARPS Monitoring Organization (SMO) at Lahore	11.05.2012	SCARPS Monitoring Organization (SMO) Director Javaid Abro PIAIP Consultants Environmental Specialist	Difficulties were expressed regarding the extended canal closure during construction phase.	It was clarified that due measures will be taken that canal will run as per usual programme with no effect on the discharge volume and will close only during routine annual closure.

Sr. No.	Meeting Place	Date	Participants	Main Concern	Replies
			Ahsan Bela Junior Environmentalists: - Afaf Ayesha - Nosheen Aslam		
9.	At Panjnad Barrage	27.05.2012	Public Members Farmer Aashiq Hussain Gopang Farmer M. Azhar Jatoi PIAIP Consultants Environmental Specialist Ahsan Bela	The concern was raised about the depletion of groundwater level. Hurdles in the movement of local people due to extra burden on road network.	The over-pumping of groundwater will not be carried out for the work activities and groundwater aquifer will not be adversely affected. Job opportunities to he local community.
10.	Head Office Wildlife Department at Lahore	28.05.2012	Wildlife Department Director General Syed Iftikhar Hussain Shah Deputy Director M. Naeem Bhatti Assistant Director M. Anwar Mann PIAIP Consultants Environmental Specialist Ahsan Bela Junior Environmentalists: - Afaf Ayesha - Nosheen Aslam	Protect the wildlife habitat by minimizing the vegetation clearance and hunting of species.	The idea of undertaking new plantation along bypass gated weir and at new island developed at western end of the barrage was appreciated very much and agreed that this will enhance the biodiversity of the area by the Wildlife Department. It was ensured that the wildlife, forestry & fishery rules & laws will be implemented during design and construction phase of the project to minimize the adverse impacts on the ecology of the area.
11.	Environment Office	08.09.2012	Environment Department	Project was briefed to the	It was agreed to prepare an EIA and

Sr. No.	Meeting Place	Date	Participants	Main Concern	Replies
	Muzaffargarh		District Officer Environment Syed Ishfaq Hussain Environment Inspectors: - Muhammad Aslam - Fiaz Hussain PIAIP Consultants Environmental Specialist Ahsan Bela	participants. It was envisaged that the project fall under schedule II of section 12 of Environment Protection Act 1997 and therefore EIA is required for this project.	submit to the EPA Punjab for NOC purpose.
12.	Forest Office Muzaffargarh	08.09.2012	Forest Department Divisional Officer Mian Jamal Iqbal District Officer Jamshed Khalid Sindho District Range Officer Ghulam Murtaza PIAIP Consultants Environmental Specialist Ahsan Bela	Prior approval from Forest Department is required for every tree need to be uprooted on site for project implementation. New Plantation shall be undertaken with the collaboration of Forest Department.	It was insured that the Contractor will be bond to consult with Forest Department before uprooting any tree on site or carrying out new plantation on site.
13.	Fishery Office Muzaffargarh	09.09.2012	Fishery Department District Officer Fishery Baker Hussain Assistant Director Fishery Malik Muhammad Rashid Inspector Fishery Mushtaq Ali Qureshi	There is only one fish ladder at Panjnad Barrage. The existing fish ladder shall be repaired widen and lengthen if possible.	Fish ladder will be examined and repair or upgrading of the fish ladder will be carried under this project.

Sr. No.	Meeting Place	Date	Participants	Main Concern	Replies
			PIAIP Consultants Environmental Specialist Ahsan Bela		
14.	Wildlife Office Muzaffargarh	08.09.2012	Wildlife Department District Officer Shahid Nawaz PIAIP Consultants Environmental Specialist Ahsan Bela	Barrage Pond area provides the habitat of water fowls. Migrating birds visit the site during winter. Wildlife Department monitors the barrage pond area to control the illegal hunting or pouching of animals. Possibly damaging the ecological environment of the area during construction phase of the project was highlighted.	It was ensured that a detailed EMP will be prepared and implement on site to control the environmental adverse impacts during construction and operational Phase of the project. Dust, noise and ambient air pollution will be controlled by regular spraying of water on earthen (kacha) tracks. Correct and tuned plants and equipments will be utilized. Water sources will be protected and monitored from the accidental spill or from the wastewater generated on site.
15.	Forest, Wildlife and Fisheries Office, Lahore	17.09.2013	Forest, Wildlife and Fisheries Department Deputy Secretary (Planning) Mr. Shahid Rashid Awan PIAIP Consultants Environmental Specialist Ahsan Bela	The Status of forests along Panjnad Barrage Possibility of tree uprooting and subsequent plantation sites	Two Reserved Forest sites were identified along Right Marginal Bund (RMB) of Barrage and the project activities are unlikely to make any impact on these sites The deforestation issue was discussed and it was informed to Deputy Secretary that five new trees will be planted for every uprooted tree at areas where there is no or little plantation in/near the area where uprooting will be done

Appendices

APPENDIX-2.1

NATIONAL ENVIRONMENTAL QUALITY STANDARDS

(1) for Annex, I the following shall be substituted, namely:_____

Annex-I

"NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MUNICIPAL AND LIQUID INDUSTRIAL EFFLUENTS (mg/I, UNLESS OTHERWISE DEFINED)

S. No.	Parameter		Revised Standards		
		Existing Standards	Into Inland Waters	Into Sewage Treatment [5]	Into Sea [ ]
1	2	3	4	5	6
1.	Temperature or Temperature Increase *	40°C	≤3°C	≤3°C	≤3°C
2.	pH value (H^+) .	6-10	6-9	6-9	6-9
3.	Biochemical Oxygen Demand $(BOD)_5$ at 20°C [1]	80	80	250	80**
4.	Chemical Oxygen Demand (COD) [1]	150	150	400	400
5.	Total Suspended Solids (TSS)	150	200	400	200
6.	Total Dissolved Solids (TDS)	3500	3500	3500	3500
7.	Oil and Grease	10	10	10	10
8.	Phenolic compounds (as phenol)	0.1	0.1	0.3	0.3
9.	Chloride (as $C1^-$)	1000	1000	1000	SC***
10.	Fluoride (as F^-)	20	10	10	10
11.	Cyanide (as CN^-) total ..	2	1.0	1.0	1.0
12.	An-ionic detergents (as MBAS) [2]	20	20	20	20
13.	Sulphate (SO_4^{2-})	600	600	1000	SC***
14.	Sulphide (S^{2-})	1.0	1.0	1.0	1.0
15.	Ammonia (NH_3)	40	40	40	40
16.	Pesticides [3]	0.15	0.15	0.15	0.15

1	2	3	4	5	6
17.	Cadmium [4]	0.1	0.1	0.1	0.1
18.	Chromium (trivalent and hexavalent [4].. ..	1.0	1.0	1.0	1.0
19.	Cooper [4]	1.0	1.0	1.0	1.0
20.	Lead [4]	0.5	0.5	0.5	0.5
21.	Mercury [4]	0.01	0.01	0.01	0.01
22.	Selenium [4]	0.5	0.5	0.5	0.5
23.	Nickel [4] ..	1.0	1.0	1.0	1.0
24.	Silver [4]	1.0	1.0	1.0	1.0
25.	Total toxic metals	2.0	2.0	2.0	2.0
26.	Zinc	5.0	5.0	5.0	5.0
27.	Arsenic [4] ..	1.0	1.0	1.0	1.0
28.	Barium [4]	1.5	1.5	1.5	1.5
29.	Iron	2.0	8.0	8.0	8.0
30.	Manganese	1.5	1.5	1.5	1.5
31.	Boron [4]	6.0	6.0	6.0	6.0
32.	Chlorine	1.0	1.0	1.0	1.0

Explanations:

1. Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent.

2. Methylene Blue Active Substances; assuming surfactant as biodegradable.

3. Pesticides include herbicides, fungicides, and insecticides.

4. Subject to total toxic metals discharge should not exceed level given at S. N. 25.

5. Applicable only when and where sewage treatment is operational and BOD_5=80mg/l is achieved by the sewage treatment system.

6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.

* The effluent should not result in temperature increase of more than 3^0C at the edge of the zone where initial mixing and dilution take place in the receiving body. In case zone is not defined, use 100 meters from the point of discharge.

** The value for industry is 200 mg/I

*** Discharge concentration at or below sea concentration (SC).

Note:_____ 1. Dilution of liquid effluents to bring them to the NEQS limiting values is not permissible through fresh water mixing with the effluent before discharging into the environment.

2. The concentration of pollutants in water being used will be substracted from the effluent for calculating the NEQS limits."

Annex-III (Amended)

NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MOTOR VEHICLE EXHAUST AND NOISE

(i) For Inuse Vehicles

S. No.	Parameter	Standards (maximum permissible limit)	Measuring method	Applicability
1	2	3	4	5
1.	Smoke	40% or 2 on the Ringlemann Scale during engine acceler-ation mode.	To be compared with Ringlemann Chart at a distance of 6 metres or more.	Immediate effect
2.	Carbon Monoxide.	6%	Under idling condi-tions : Non-disper-sive infrared detec-tion through gas analyzer.	
3.	Noise	85 db (A).	Sound-meter at 7.5 meters from the source.	

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PART II

Statutory Notifications (S. R. O.)

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT

NOTIFICATIONS

Islamabad, the 18th October, 2010

S. R. O. 1062(I)/2010.—In exercise of the powers conferred under clause (c) of sub-section (I) of section 6 of the Pakistan Environmental Protection Act, 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to establish the following National Environmental Quality Standards for Ambient Air.

National Environmental Quality Standards for Ambient Air

Pollutants	Time-weighted average	Concentration in Ambient Air		Method of Measurement
		Effective from 1st July 2010	Effective from 1st January 2013	
Sulphur Dioxide (SO_2)	Annual Average*	80µg/m^3	80µg/m^3	Ultraviolet Fluorescence Method
	24 hours**	120µg/m^3	120µg/m^3	
Oxides of Nitrogen as (NO)	Annual Average*	40µg/m^3	40µg/m^3	Gas Phase Chemiluminescence
	24 hours**	40µg/m^3	40µg/m^3	

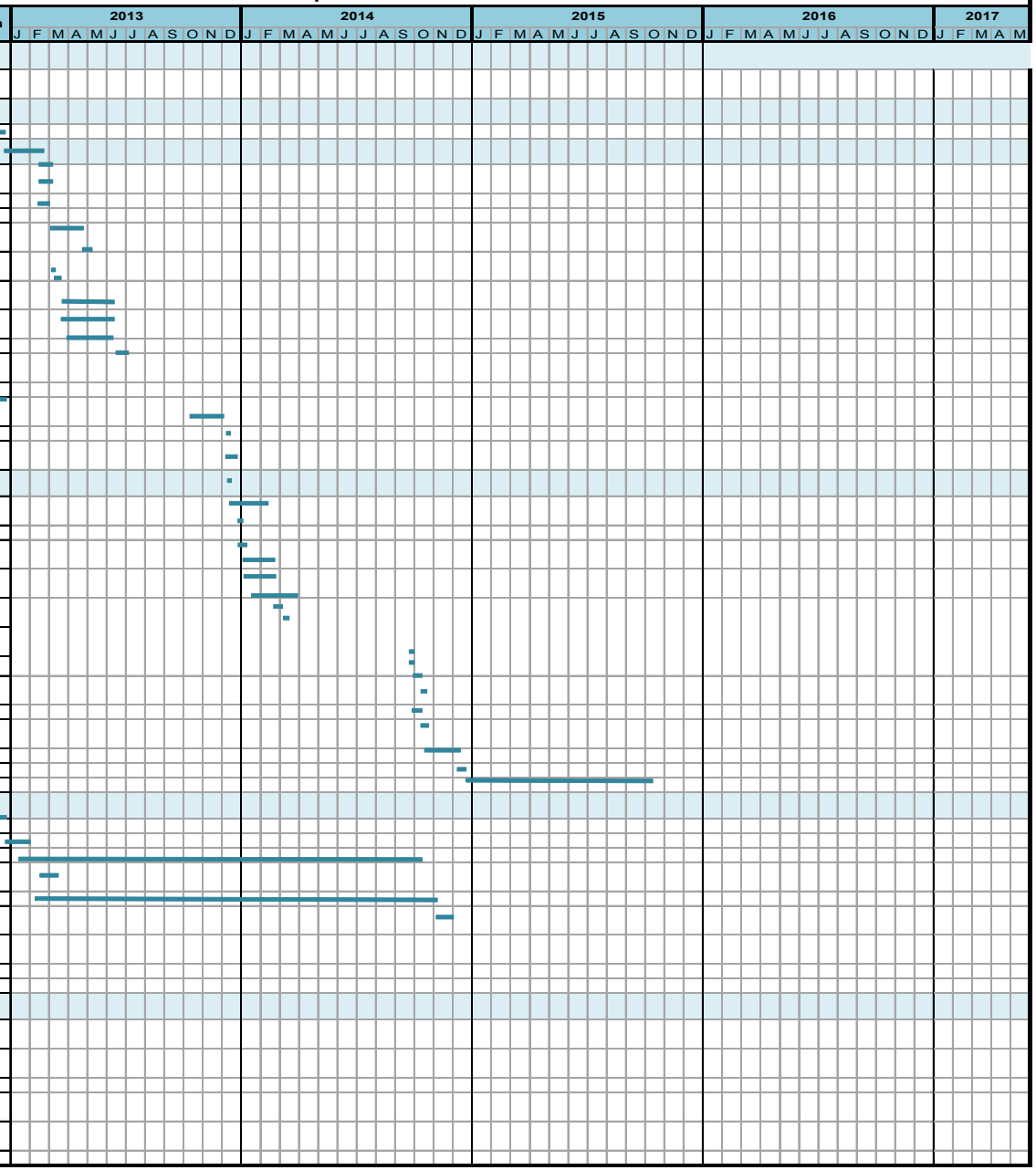
Oxides of Nitrogen as (NO_2)	Annual Average*	40µg/m^3	40µg/m^3	Gas Phase Chemiluminescence
	24 hours**	80µg/m^3	80µg/m3	
Ozone (O_3)	1 hour	180µg/m^3	130µg/m^3	Non disperse UV absorption method
Suspended Particulate Matter (SPM)	Annual Average*	400µg/m^3	360µg/m^3	High Volume Sampling, (Average flow rate not less than 1.1m^3/minute)
	24 hours**	550µg/m^3	500µg/m^3	
Respire able Particulate Matter (PM_{10})	Annual Average*	200µg/m^3	120µg/m^3	ß-Ray Absorption Method
	24 hours**	250µg/m^3	150µg/m^3	
Respire able Particulate Matter (PM_{25})	Annual Average*	25µg/m^3	15µg/m^3	ß-Ray Absorption Method
	24 hours**	40µg/m^3	35µg/m^3	
	1 hour	25µg/m^3	15µg/m^3	
Lead (Pb)	Annual Average*	1.5µg/m^3	1µg/m^3	AAS Method after sampling using EPM 2000 or equivalent Filter paper
	24 hours**	2µg/m^3	1.5µg/m^3	
Carbon Monoxide (CO)	8 hours**	5µg/m^3	5µg/m^3	Non Dispersive Infrared (NDIR) method
	1 hour	10µg/m^3	10µg/m^3	
*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform intervals.				
**24 hourly/8 hourly values should be met 98% in a year. 2% of the time, it may exceed but not on two consecutive days.				

APPENDIX-3.1

CONSTRUCTION SCHEDULE

R & U OF PANJNAD BARRAGE
Construction Schedule of Recommended Option

Activity ID	ACTIVITY DESCRIPTION	Earliest Start	Earliest Finish
GENERAL ITEMS			
G010	Notice to Commence Work after Submission of Advance Payment Security	3/3/13	2/4/2013
PRECONSTRUCTION ACTIVITIES			
P010	Construction of Preliminary Works & Facilities	01/05/13	30/9/2013
EXISTING BARRAGE REHABILITATION PHASE-1 (RIGHT SIDE & LEFT SIDE OF BARRAGE)			
EBR1 010	Tamping of gates No. 22-47 to stop leakage of water	1/10/2013	31/10/13
EBR1 020	D/S cofferdams C1 bay No. 22-47 (top EL 339.15)	1/11/2013	4/1/2014
EBR1 030	U/S cofferdams C2 bay No. 22-47 (top EL 342.50)	5/1/2014	31/1/2014
EBR1 040	Constructing cofferdams C3 U/S in bay No. 1-4 (Top EL 342.50)	5/1/2014	31/01/2014
EBR1 050	Construction of link diversion between Abbasia & Abbasia link canals	5/1/2014	25/01/2014
EBR1 060	Mechanical works for Panjnad canal, Abbasia canal & barrage bay No. 1-4	1/2/2014	31/03/2014
EBR1 070	Dismantling U/S & D/S cofferdams of barrage bays No. 1-4 for feeding Panjnad	1/4/2014	15/04/2014
EBR1 080	Raising of pond level for canal operation	1/2/2014	5/2/2014
EBR1 090	Setting up Dewatering arrangements and dewatering	6/2/2014	20/02/2014
EBR1 100	Mechanical Works of barrage bays No. 24-47	21/02/2014	31/05/2014
EBR1 110	Execution of civil works for D/S floor in bays No.24-47	21/02/2014	31/05/2014
EBR1 120	Electrical works of right portion of Barrage	1/3/2014	31/05/2014
EBR1 130	Dismantling U/S and D/S cofferdams in front of bays No. 22-47	10/6/2014	30/06/2014
EXISTING BARRAGE REHABILITATION PHASE-II (Left side of Barrage)			
EBR2 010	Tamping of gates No. 1-26 to stop leakage of water	1/10/2013	31/10/2013
EBR2 020	D/S cofferdams bays No.1-26 C4(Top EL 339.15)	1/11/2014	4/1/2015
EBR2 030	U/S cofferdams bays No.1-4 C5-a(Top EL 342.50)	5/1/2015	12/1/2015
EBR2 040	U/S cofferdams bays No.1-26 C5-b(Top EL 342.50)	13/01/2015	31/01/2015
EBR2 050	Setting up Dewatering arrangements and dewatering in bays No 1-4	13/01/2015	16/01/2015
EBR2 060	Remaining Mechanical Works of canals and bays No 1-4	17/01/2015	31/03/2015
EBR2 070	Raising of pond level for canal operation	1/2/2015	3/2/2015
EBR2 080	Setting up Dewatering arrangements and dewatering in bays No 5-26	4/2/2015	15/02/2015
EBR2 090	Mechanical Works of bays No. 5-23	16/02/2015	15/04/2015
EBR2 100	Constructing civil works for U/S and D/S floor in bays No.1-23 and divide wall middle portion	16/02/2015	15/04/2015
EBR2 110	Electrical works of left portion of Barrage	1/3/2015	31/05/2015
EBR2 120	Dismantling U/S and D/S cofferdams	16/04/2015	30/04/2015
EBR2 130	Raising Panjnad Canal	1/5/2015	5/5/2015
EXISTING BARRAGE REHABILITATION PHASE- III (Left side of Barrage)			
EBR3 010	U/S cofferdams C6 bay No.1-4 (Top EL 332)	5/1/2016	15/01/2016
EBR3 020	U/S cofferdams C7 bay No.1-7 (Top EL 337)	5/1/2016	15/01/2016
EBR3 030	Mechanical and civil works of Abbasia Link Canal	16/01/2016	31/01/2016
EBR3 040	Dismantling Cofferdam C6 to feed Abbasia Link canal	1/2/2016	3/2/2016
EBR3 050	Raising Cofferdam C7 upto RL 342.50	16/01/2016	31/01/2016
EBR3 060	Setting up Dewatering arrangements and dewatering in bay No 1-7	1/2/2016	8/2/2016
EBR3 070	Constructing part of divide wall middle portion and entire extended portion	9/2/2016	15/04/2016
EBR3 080	Dismantling Cofferdam C7	16/04/2016	30/04/2016
EBR3 090	Defect Liability Period	1/5/2016	30/04/2017
For Flood Management Option 15-8			
FM 010	Diversion of Uch - Alipur road section within the boundary of new structure.	1/10/2013	31/10/2013
FM 020	D/S cofferdam C8 on the right side (Top EL. 342.75)	1/11/2013	20/12/2013
FM 030	Installation / operation of dewatering arrangements	30/11/2013	31/01/2016
FM 040	U/S cofferdam C9 from right guide bank to first J spur (Top EL. 343.50)	8/1/2014	15/02/2014
FM 050	Construction of 731 ft. long new concrete structure with road bridge	1/1/2014	29/02/2016
FM 060	Removal of Cofferdam C8 & C9	1/3/2016	31/03/2016



APPENDIX-3.2

ANTICIPATED WATER LEVELS AT PANJNAD

(FOR 865,000 CUSECS)

Anticipated water levels for 865,000 cusecs at Panjnad						
		Water levels				
Section No.	RD of x-section along RMB	Case 1	Case 2	Difference (ft.)		
16	25+767	350.14	349.83	0.31	3.72	in
15	24+457	349.94	349.62	0.32	3.84	in
14	23+155	349.82	349.49	0.33	3.96	in
13	21+851	349.68	349.33	0.35	4.2	in
12	20+548	349.55	349.2	0.35	4.2	in
11	19+251	349.29	348.92	0.37	4.44	in
10	18+158	349.06	348.67	0.39	4.68	in
9	17+125	348.85	348.44	0.41	4.92	in
8	16+140	348.51	348.07	0.44	5.28	in
7	15+156	348.14	347.67	0.47	5.64	in
6	14+172	347.46	346.9	0.56	6.72	in
5	13+188	347.33	346.76	0.57	6.84	in
4	12+204	346.96	346.36	0.6	7.2	in
3	11+220	345.03	344.23	0.8	9.6	in
2	10+235	344.08	343.12	0.96	11.52	in
1	9+223	343.52	342.44	1.08	12.96	in
0	0+000	342.75	341.5	1.25	15	in
Case 1: Water levels u/s of Barrage with reference to 1973 flood level 341.50 (HFL)						
Case 2: Water levels u/s of Barrage with reference to design flood (Q=865,000)						
Peak discharge is expected to remain for a maximum period of 24 hours						

APPENDIX 4.1

BORE HOLE LOG

FIGURE # 3.1

REFERENCES

RIVER 2007

RIVER 2008

PBH = PANJNAD BOREHOLE

PBH-8

NORTH

BASTI DIDA

RIGHT MARGINAL BUND

LEFT MARGINAL BUND

BRIDGE-ING SECTION RD 29-30

BRIDGE-ING SECTION RD 19-21

EMBANKMENT 1650 M

J-HEAD SPUR NO.II AT RD 23500 RMB

J-HEAD SPUR NO.III AT RD 18320 RMB

J-HEAD SPUR NO.I AT RD 16500 RMB

J-HEAD SPUR AT RD 12750

FLOW

BELA (SHOAL)

ALIPUR-PANJNAD ROAD

PBH-1 PBH-2 PBH-3 PBH-4 PBH-5 PBH-6 PBH-7 PBH-8 PBH-9 PBH-10 PBH-11 PBH-12 PBH-13 PBH-14 PBH-15 PBH-16 PBH-17 PBH-18 PBH-19 PBH-20 PBH-21

L.C.B.

600

PANJNAD HEADWORKS

SCHEDULE OF BORE HOLES

BH No.	DEPTH (FL)
PBH-1	50
PBH-2	50
PBH-3	50
PBH-4	15
PBH-5	50
PBH-6	50
PBH-7*	120
PBH-8	70
PBH-9*	120
PBH-10	50
PBH-11*	120
PBH-12	70
PBH-13	46
PBH-14	50
PBH-15	50
PBH-16	50
PBH-17	50
PBH-18	50
PBH-19	40
PBH-20	40
PBH-21	40
TOTAL	1231

*ALONG ALIPUR-PANJNAD ROAD.

GOVERNMENT OF THE PUNJAB
IRRIGATION & POWER DEPARTMENT
PUNJAB IRRIGATED AGRICULTURE INVESTMENT PROGRAM
NESPAK-AAB-DMC
REHABILITATION & UPGRADING OF PANJNAD BARRAGE
PANJNAD HEADWORKS
BOREHOLE PLAN FOR
GEOTECHNICAL INVESTIGATIONS

GEO BAND Works Management

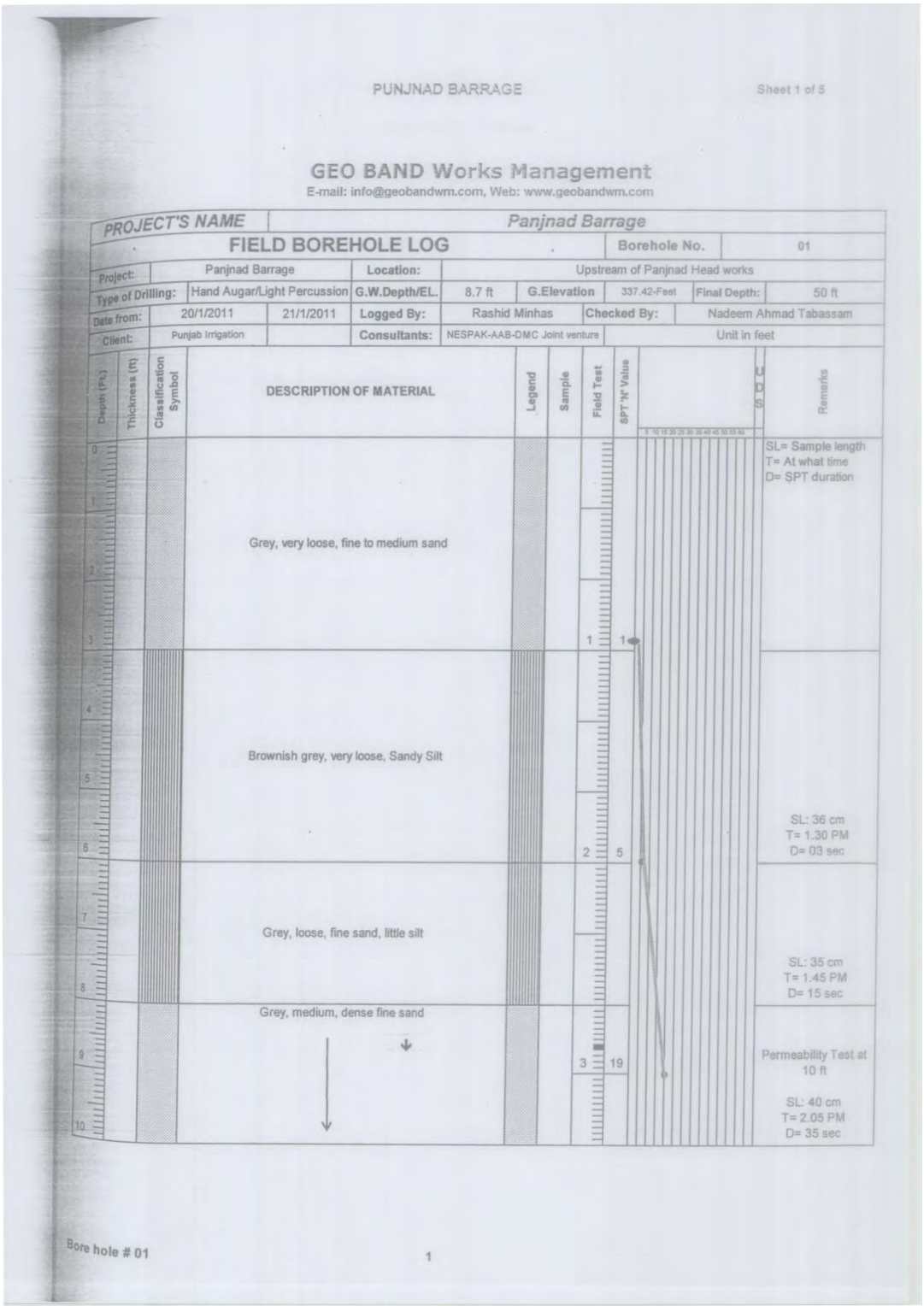
E-mail: info@geobandwm.com, Web: www.geobandwm.com

PROJECT'S NAME	Panjnad Barrage						
FIELD BOREHOLE LOG					Borehole No.	01	
Project:	Panjnad Barrage	Location:	Upstream of Panjnad Head works				
Type of Drilling:	Hand Augar/Light Percussion	G.W.Depth/EL.	8.7 ft	G.Elevation	337.42-Feet	Final Depth:	50 ft
Date from:	20/1/2011	21/1/2011	Logged By:	Rashid Minhas	Checked By:	Nadeem Ahmad Tabassam	
Client:	Punjab Irrigation		Consultants:	NESPAK-AAB-DMC Joint venture	Unit in feet		

Depth (FL)	Thickness (ft)	Classification Symbol	DESCRIPTION OF MATERIAL	Legend	Sample	Field Test	SPT 'N' Value	Remarks
11								
12						4	11	
13			Brownish, stiff Clayey silt, little sand					
14								
15						5	4	SL: 34 cm T= 2.30 PM D= 25 sec
16			Brownish, grey, loose to loose, silty sand					
17								
18						6	12	SL: 35 cm T= 2.30 PM D= 20 sec
19			Grey, medium dense, fine Silty Sand, trace clay					Permeability Test at 20 ft
20								SL: 36 cm T= 3.10 PM D= 25 sec

Bore hole # 01

2



PUNJNAD BARRAGE

Sheet 1 of 5

GEO BAND Works Management

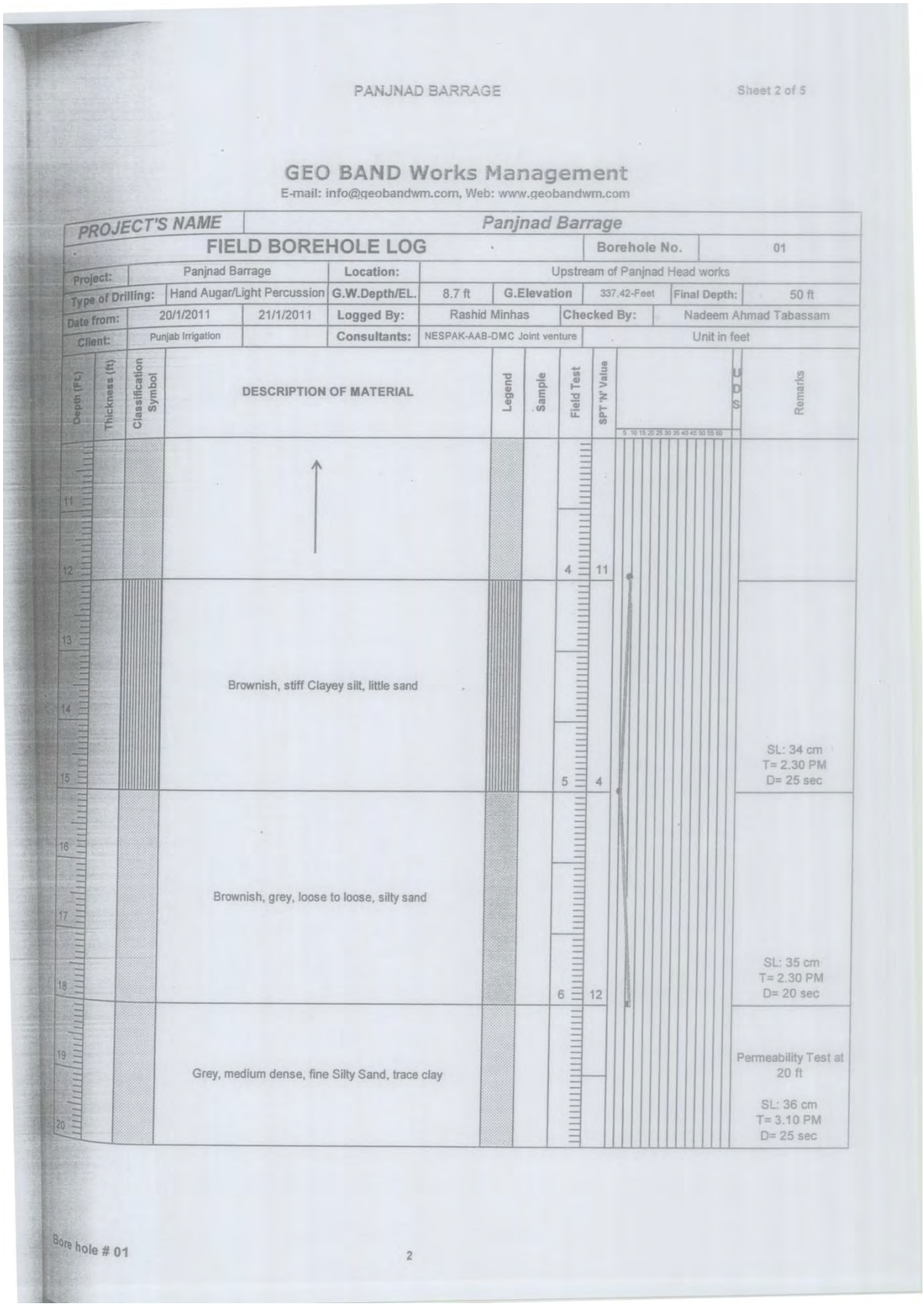
E-mail: info@geobandwm.com, Web: www.geobandwm.com

PROJECT'S NAME	Panjnad Barrage						
FIELD BOREHOLE LOG					Borehole No.	01	
Project:	Panjnad Barrage	Location:	Upstream of Panjnad Head works				
Type of Drilling:	Hand Augar/Light Percussion	G.W.Depth/EL.	8.7 ft	G.Elevation	337.42-Feet	Final Depth:	50 ft
Date from:	20/1/2011	21/1/2011	Logged By:	Rashid Minhas	Checked By:	Nadeem Ahmad Tabassam	
Client:	Punjab Irrigation		Consultants:	NESPAK-AAB-DMC Joint venture	Unit in feet		

Depth (Ft.)	Thickness (ft)	Classification Symbol	DESCRIPTION OF MATERIAL	Legend	Sample	Field Test	SPT 'N' Value	Remarks
0			Grey, very loose, fine to medium sand			1	1	SL= Sample length T= At what time D= SPT duration
6			Brownish grey, very loose, Sandy Silt			2	5	SL: 36 cm T= 1.30 PM D= 03 sec
8			Grey, loose, fine sand, little silt					SL: 35 cm T= 1.45 PM D= 15 sec
10			Grey, medium, dense fine sand			3	19	Permeability Test at 10 ft SL: 40 cm T= 2.05 PM D= 35 sec

Bore hole # 01

1



PANJNAD BARRAGE

Sheet 2 of 5

GEO BAND Works Management

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PROJECT'S NAME	Panjnad Barrage						
FIELD BOREHOLE LOG					Borehole No.	01	
Project:	Panjnad Barrage	Location:	Upstream of Panjnad Head works				
Type of Drilling:	Hand Augar/Light Percussion	G.W.Depth/EL.	8.7 ft	G.Elevation	337.42-Feet	Final Depth:	50 ft
Date from:	20/1/2011	21/1/2011	Logged By:	Rashid Minhas	Checked By:	Nadeem Ahmad Tabassam	
Client:	Punjab Irrigation		Consultants:	NESPAK-AAB-DMC Joint venture	Unit in feet		

Depth (Ft.)	Thickness (ft)	Classification Symbol	DESCRIPTION OF MATERIAL	Legend	Sample	Field Test	SPT 'N' Value	U.C.S.	Remarks
11			↑						
12						4	11		
13			Brownish, stiff Clayey silt, little sand						
14									
15						5	4		SL: 34 cm T= 2.30 PM D= 25 sec
16									
17			Brownish, grey, loose to loose, silty sand						
18						6	12		SL: 35 cm T= 2.30 PM D= 20 sec
19			Grey, medium dense, fine Silty Sand, trace clay						Permeability Test at 20 ft SL: 36 cm T= 3.10 PM D= 25 sec
20									

Bore hole # 01

2

PANJNAD BARRAGE Sheet 3 of 5

GEO BAND Works Management

E-mail: info@geobandwm.com. Web: www.geobandwm.com

PROJECT'S NAME	Panjnad Barrage						
FIELD BOREHOLE LOG					Borehole No.	01	
Project:	Panjnad Barrage	Location:	Upstream of Panjnad Head works				
Type of Drilling:	Hand Augar/Light Percussion	G.W.Depth/EL.	8.7 ft	G.Elevation	337.42-Feet	Final Depth:	50 ft
Date from:	20/1/2011	21/1/2011	Logged By:	Rashid Minhas	Checked By:	Nadeem Ahmad Tabassam	
Client:	Punjab Irrigation		Consultants:	NESPAK-AAB-DMC Joint venture	Unit in feet		

Depth (Ft.)	Thickness (ft)	Classification Symbol	DESCRIPTION OF MATERIAL	Legend	Sample	Field Test	SPT 'N' Value	Remarks
21			Grey, medium, desne fine sand in lower part. Brown clayey silt in upper part.			7	7	
22								
23								
24								
25								
26						8	12	SL: 38 cm T= 3.20 PM D= 21 sec
27			Grey, medium, desne fine sand in lower part. Brown clayey silt in upper part.					
28								
29								
30								SL: 35 cm T= 3.38 PM D= 30 sec

Bore hole # 01

3

PANJNAD BARRAGE Sheet 4 of 5

GEO BAND Works Management

E-mail: info@geobandwm.com. Web: www.geobandwm.com

PROJECT'S NAME	Panjnad Barrage						
FIELD BOREHOLE LOG					Borehole No.	01	
Project:	Panjnad Barrage	Location:	Upstream of Panjnad Head works				
Type of Drilling:	Hand Augar/Light Percussion	G.W.Depth/EL.	8.7 ft	G.Elevation	337.42-Feet	Final Depth:	50 ft
Date from:	20/1/2011	21/1/2011	Logged By:	Rashid Minhas	Checked By:	Nadeem Ahmad Tabassam	
Client:	Punjab Irrigation		Consultants:	NESPAK-AAB-DMC Joint venture	Unit in feet		

Depth (Ft.)	Thickness (ft)	Classification Symbol	DESCRIPTION OF MATERIAL	Legend	Sample	Field Test	SPT 'N' Value	UCS	Remarks
31						9	16		
32			Grey, medium dense fine sand						
33									
34									
35									SL: 20 cm T= 4.00 PM D= 20 sec
36						10	23		
37			Grey, medium dense fine Silty Sand to medium sand. Poorly sorted						
38									
39									
40									SL: 40 cm T= 4.33 PM D= 40 sec

Bore hole # 01

4

PANJNAD BARRAGE

Sheet 5 of 5

GEO BAND Works Management

E-mail: info@geobandwm.com, Web: www.geobandwm.com

PROJECT'S NAME	Panjnad Barrage						
FIELD BOREHOLE LOG					Borehole No.	01	
Project:	Panjnad Barrage	Location:	Upstream of Panjnad Head works				
Type of Drilling:	Hand Augar/Light Percussion	G.W.Depth/EL.	8.7 ft	G.Elevation	337.42-Feet	Final Depth:	50 ft
Date from:	20/1/2011	21/1/2011	Logged By:	Rashid Minhas	Checked By:	Nadeem Ahmad Tabassam	
Client:	Punjab Irrigation		Consultants:	NESPAK-AAB-DMC Joint venture	Unit in feet		

Depth (Ft.)	Thickness (ft)	Classification Symbol	DESCRIPTION OF MATERIAL	Legend	Sample	Field Test	SPT 'N' Value	Remarks
41						11	20	
42			Grey, medium dense fine sand to medium sand. Poorly sorted					
43								
44								
45								
46						12	18	Washed T= 5.04 PM D= 38 sec
47			Grey, medium dense fine sand to medium sand. Poorly sorted					
48								
49								Washed T= 9.30 PM D= 32 sec
50			Grey, medium dense fine sand to medium sand. Poorly sorted			13	16	Washed T= 10.30 PM D= 30 sec

Bore hole # 01

5

PANJNAD BARRAGE

Sheet 1 of 5

GEO BAND Works Management

E-mail: info@geobandwm.com, Web: www.geobandwm.com

PROJECT'S NAME	Panjnad Barrage						
FIELD BOREHOLE LOG					Borehole No.	PBH-03	
Project:	Panjnad Barrage	Location:	Upstream of Panjnad Head Works (at Bela)				
Type of Drilling:	Hand Augar/Light Percussion	G.W.Depth/EL.	8.6 ft	G.Elevation	336.77	Final Depth:	50 ft
Date from:	19/1/2011	19/1/2011	Logged By:	Rashid Minhas	Checked By:	Nadeem Ahmad Tabessum	
Client:	Punjab Irrigation		Consultants:	NESPAK-AAB-DMC Joint venture	Unit in feet		

Depth (Ft.)	Thickness (ft)	Classification Symbol	DESCRIPTION OF MATERIAL	Legend	Sample	Field Test	SPT 'N' Value (5 10 15 20 25 30 35 40 45 50 55 60)	U D S	Remarks
0	3		Grey, very loose to loose, silty sand						SL= Sample length T= At what time D= SPT duration
3	3		Brown, soft to firm "Clayey Silt" slight to medium plastic			1	4		SL: 36 cm T= 12.16 PM D= 20 sec
6	2		Grey, loose, fine to medium Silty sand			2	8		SL: 30 cm T= 12.30 PM D= 25 sec
8	2		Grey, medium, dense fine to medium sand ↓			3	17		Permeability Test at 10 ft SL: 13 cm T= 12.45 PM D= 30 sec

Bore hole # 03

1

PANJNAD BARRAGE Sheet 2 of 5

GEO BAND Works Management

E-mail: info@geobandwm.com, Web: www.geobandwm.com

PROJECT'S NAME	Panjnad Barrage						
FIELD BOREHOLE LOG					Borehole No.	PBH-03	
Project:	Panjnad Barrage	Location:	Upstream of Panjnad Head Works (at Bela)				
Type of Drilling:	Hand Augar/Light Percussion	G.W.Depth/EL.	8.6 ft	G.Elevation	336.77	Final Depth:	50 ft
Date from:	19/1/2011	19/1/2011	Logged By:	Rashid Minhas	Checked By:	Nadeem Ahmad Tabessum	
Client:	Punjab Irrigation		Consultants:	NESPAK-AAB-DMC Joint venture	Unit in feet		

Depth (FL)	Thickness (ft)	Classification Symbol	DESCRIPTION OF MATERIAL	Legend	Sample	Field Test	SPT 'N' Value	UDS	Remarks
11			↑						
12									
13			Grey, medium, dense fine to medium sand						
14									
15						4	20		SL: 45 cm T= 1.00 PM D= 31 sec
16			Grey, medium, dense fine to medium sand						
17									
18						5	10		SL: 40 cm T= 2.05 PM D= 25 sec
19			Grey, loose, fine sand, trace silt						Permeability Test at 20 ft
20						6	5		SL: 37 cm T= 2.40 PM D= 15 sec

Bore hole # 03 2

PANJNAD BARRAGE Sheet 3 of 5

GEO BAND Works Management

E-mail: info@geobandwm.com, Web: www.geobandwm.com

PROJECT'S NAME	Panjnad Barrage						
FIELD BOREHOLE LOG					Borehole No.	PBH-03	
Project:	Panjnad Barrage	Location:	Upstream of Panjnad Head Works (at Bela)				
Type of Drilling:	Hand Augar/Light Percussion	G.W.Depth/EL.	8.6 ft	G.Elevation	336.77	Final Depth:	50 ft
Date from:	19/1/2011	19/1/2011	Logged By:	Rashid Minhas	Checked By:	Nadeem Ahmad Tabessum	
Client:	Punjab Irrigation		Consultants:	NESPAK-AAB-DMC Joint venture	Unit in feet		

Depth (Ft.)	Thickness (ft)	Classification Symbol	DESCRIPTION OF MATERIAL	Legend	Sample	Field Test	SPT 'N' Value	Remarks
21			Brown, soft to firm clayey silt, trace sand.			7	4	SL: 40 cm T= 3.12 PM D= 15 sec
22								
23								
24								
25								
26								
27			Brownish grey, medium dense fine sand, little silt.			8	48	SL: 36 cm T= 3.37 PM D= 110 sec
28								
29								
30								

Bore hole # 03

3

PANJNAD BARRAGE Sheet 4 of 5

GEO BAND Works Management

E-mail: info@geobandwm.com, Web: www.geobandwm.com

PROJECT'S NAME	Panjnad Barrage						
FIELD BOREHOLE LOG					Borehole No.	PBH-03	
Project:	Panjnad Barrage	Location:	Upstream of Panjnad Head Works (at Bela)				
Type of Drilling:	Hand Augar/Light Percussion	G.W.Depth/EL.	8.6 ft	G.Elevation	336.77	Final Depth:	50 ft
Date from:	19/1/2011	19/1/2011	Logged By:	Rashid Minhas	Checked By:	Nadeem Ahmad Tabessum	
Client:	Punjab Irrigation		Consultants:	NESPAK-AAB-DMC Joint venture	Unit in feet		

Depth (Ft.)	Thickness (ft)	Classification Symbol	DESCRIPTION OF MATERIAL	Legend	Sample	Field Test	SPT 'N' Value	Remarks
31								
32			Grey, medium dense fine Silty sand, trace clay			9	16	SL: 12 cm T= 4.05 PM D= 50 sec
33								
34								
35								
36								
37			Grey, medium dense fine sand, trace silt			10	17	Washed T= 4.35 PM D= 74 sec
38								
39								
40								

Bore hole # 03

4

PUNJNAD BARRAGE Sheet 5 of 5

GEO BAND Works Management

E-mail: info@geobandwm.com, Web: www.geobandwm.com

PROJECT'S NAME	Panjnad Barrage						
FIELD BOREHOLE LOG					Borehole No.	PBH-03	
Project:	Panjnad Barrage	Location:	Upstream of Panjnad Head Works (at Bela)				
Type of Drilling:	Hand Augar/Light Percussion	G.W.Depth/EL.	8.6 ft	G.Elevation	336.77	Final Depth:	50 ft
Date from:	19/1/2011	19/1/2011	Logged By:	Rashid Minhas	Checked By:	Nadeem Ahmad Tabessum	
Client:	Punjab Irrigation		Consultants:	NESPAK-AAB-DMC Joint venture	Unit in feet		

Depth (ft)	Thickness (ft)	Classification Symbol	DESCRIPTION OF MATERIAL	Legend	Sample	Field Test	SPT 'N' Value	5 10 15 20 25 30 35 40 45 50 55 60	Remarks
			↑						
			Grey, medium dense fine sand trace silt			11	12		SL= 35 cm T= 5.33 PM D= 50 sec
			Grey, medium, dense fine, medium sand, little concretion (Fine gravels of 4.6 mm to 10 mm size)			12	13		Washed T= 6.00 PM D= 48 sec
			Grey, medium densem, fine to medium sand. Trace concretion (Gravels 4.6 to 8 mm)			13	17		SL= 45 cm T= 6.30 PM D= 80 sec

Pole # 03 5

APPENDIX- 4.2

SAMPLING PROCEDURE AND TEST RESULTS

Global Environmental Lab

Environmental Monitoring
Of
Panjnad Barrage Project Area

Final Report

January/2011

Punjab Irrigated Agriculture Investment Program (PIAIP)

Office: 218/219-A Phase-II Government Employees Cooperative Housing Society (GECHS) Model Town link Road Lahore Pakistan

Global Environmental Lab

Table of Contents

List of Tables

List of Annexes

1.0 Introduction

Barrages play a vital role in the economy of the country and hold a strategic position in the irrigation system of the province and require in time remedial measures in shape of rehabilitation and up-grading (R & U) of old barrages to avert any mishap, which can generate catastrophic conditions. To address problems associated with Punjab Irrigation System, Government of Punjab has initiated Punjab Irrigated Agriculture Investment Program (PIAIP) with financial assistance from Asian Development Bank (ADB). R & U of Panjnad barrage is one of the sub project under PIAIP.

Panjnad Barrage is the last barrage constructed during 1927 – 32 under the development of Sutlej Valley Project (SVP). The barrage is located at latitude 29° – 21' North and longitude 71° – 02' East below the confluence of River Chenab and Sutlej. The design discharge of the Barrage is 700,000 cusec. The Barrage consist of two parts; 33 bays on the left constitute the main weir and 14 bays on the right, known as Annexe weir. The total width of the Barrage is 3400 Feet. An important national highway "Multan – Muzaffargarh – Pajnad – Karachi" passes over this Barrage. Three canals namely Panjnad Canal, Abbasia Canal and Abbasia Link Canal off – take from the left flank of the Barrage.

The proposed R&U of Panjad Barrage will comprise remodeling of existing barrage and construction of new structure and a by-pass channel with road bridge for the management of additional flood more than its design capacity.

In this connection, the PIAIP Consultants –J.V of NESPAK, DMC & AAB (herein after referred as "Client") requested Global Environmental Lab to carry out Environmental Testing for the proposed site.

This report describes the environmental monitoring of the project area.

2.0 Study Methodology

This section describes the methodology that was adopted to meet the study objectives. Broadly, the tasks undertaken included:

- Development of a sampling and spot testing plan for water quality, both ground and surface water
- Team organization for field sampling, spot testing and laboratory testing.
- Discussion and meetings with representatives of concern agencies to finalize the implementation plan.
- Identification of sampling sites.
- Implementation of quality control and assurance protocols during sampling, spot testing, sample handling, transportation, and laboratory testing.

3.0 Sampling Plan

Prior to field sampling and testing, a sampling plan for water quality analysis and air quality monitoring in the desired area was made. A detailed and thorough examination of the given map was made, for the identification of sampling points for ground water, surface water, Noise Level and ambient air quality monitoring as a part of environmental monitoring program. The sampling points identified by PIAIP and GEL were scrutinized, and the final locations were given by the client. The idea of collecting the most representative and polluted samples was kept in mind while finalizing the locations.

3.1 Water Samples Location

Over all one ground water and three surface water samples were collected from the following sources. (See Annex-A,B, C & D)

1. Surface Water (Chenab River)

2. Surface Water (Sutlej River)
3. Surface Water (Barrage)
4. Ground water (Tube well Irrigation Dept. Colony)

3.2 Noise Level Monitoring Location

1. Panjnad Barrage at Alipur Road (Westerns Side)
2. Panjnad Barrage at Alipur Road (Eastern Side)

3.3 Ambient Air Monitoring Location

1. Panjnad Barrage at Alipur Road (Westerns Side)

4.0 Identification of Sampling Sites

Locations for water sample collection with sampling identification numbers are given in Table 1, the locations for Noise Level is given in Table 2 and the location for ambient air quality monitoring is given in Table 3. Parameters identified for testing are presented in Table- 4 & 5.

Table-1 Details of Sampling Sites for Ground and Surface Water

S. No.	Lab Code	Sample Code	Location	Nature
1	W/13755	SW-1	Chenab River	Surface Water
2	W/13756	SW-2	Sutlej River	Surface Water
3	W/13757	SW-3	Barrage	Surface Water
4	W/13757	GW-4	Tube well Irrigation Dept. Colony	Ground Water

Table-2 Details of Sampling Sites for Ambient Air Quality and Noise

S. No.	Lab Code	Sample Code	Location	Nature
1	S/13753	N-1	Panjnad Barrage at Alipur Road (Western Side)	Noise Level
2	S/13754	N-2	Panjnad Barrage at Alipur Road (Eastern Side)	Noise Level

Table-3 Details of Sampling Sites for Ambient Air Quality and Noise

S. No.	Lab Code	Sample Code	Location	Nature
1	A/13752	A-1	Panjnad Barrage at Alipur Road (Western Side)	Ambient Air

5.0 Team Organization

Surface Water, Ground water, Noise Level and air quality sampling and testing activities were scheduled to complete within a stipulated period of 3 days. To achieve this target GEL has constituted two separate teams, for the collection of samples and testing in laboratory. They were responsible to collect the samples according to the work plan and undertake laboratory testing.

6.0 Sample Procedures

Standard sampling procedures were followed at each site to ensure the integrity of the samples collected and validity of test results. Prior to sampling and laboratory testing, discussions were held with the client and GEL representatives, regarding sampling, sample handling, and transfer procedures, identification, and transportation of samples. The sampling procedures followed by GEL teams throughout field-testing are briefly outlined below:

6.1 The water sampling and spot testing teams were given checklist, Field data Form, complete instructions on the importance and significance of correct sampling procedures. Polyethylene bottles were used to collect water samples. For Microbiology sampling, sterilized containers were used.

6.2 Manual sampling procedures were adopted for the collection of water Samples.

6.3 As general rule, it is best to analyze the sample as soon as possible after collection. Samples were preserved in an icebox at or near 4°C immediately after collection.

6.3.1 Nitric acid and Sulphuric acid were added to the sampling bottles in quantities, sufficient to lower the pH of the samples to just about 2, to stabilize the concentration of total and dissolved metals for a maximum of 28 days.

6.4 Standard sample transfer procedures were followed to avoid confusion in Sample identification, including labeling, and safe transportation to the GEL laboratories.

6.5 Sample bottles were given identification numbers immediately after the Samples were collected. A custody transfer record, containing the following information, was attached to the sampling bottle:

- Sample identification number
- Sample origin
- Sample date and time
- Sample type (composite or grab)
- Sample conditions (source, site, temperature, pH)
- Sample preservation (for dissolved metals)
- Analysis required
- Sample shipping time

- Sample integrity (sealed, leaks, tagged, iced)
- Sampler name

All water samples collected after proper preservation were stored in an ice-box. The samples were transported to GEL Lahore by car maintaining proper conditions of refrigeration using an ice box.

7.0 Sampling Methodology

This section describes the methodology that was adopted for the purpose of sampling to meet the study objectives. Broadly, the tasks undertaken included:

- Development of a sampling and laboratory/spot testing plan for water quality monitoring.
- Team organization for field sampling; spot testing, and laboratory testing.
- Determine techniques to preserve the samples
- Identification of sampling sites
- Implementation of quality control assurance protocols during sampling, spot testing, sample handling, transportation, and laboratory testing.

7.1 Method of Sampling

Samples were collected manually according to method described in Standard Method for Examination of water by APHA (USA). Extreme care was taken during the sampling and only trained persons were entrusted the task of sampling.

7.2 Volume of Sample

2.0 Litre volume was collected to perform all the required analysis. Samples were collected in two portions. One portion was chemically preserved for estimation of metals and the other was taken in the sterilized bottles and kept at 4 °C in Ice box.

7.3 Preservation and Handling of Samples

Samples were collected to meet the requirement of the sampling program and handled them so that samples did not deteriorate or become contaminated before they reached the laboratory. Samples were stored in appropriate container with preservatives to maintain the integrity of the sample. Appropriate selection of containers and pretreatment of containers were made whenever necessary. The samples were kept in the ice box at an appropriate temperature. While transportation the important conservation techniques were kept into consideration (Temp. and pH control etc.). The samples were analyzed as soon as possible to get reliable results.

7.4 Methods of Preservation

Methods of preservation are relatively limited and intended generally to

- Retard biological action
- Retard hydrolysis of chemical compounds and complexes,
- Reduce volatility of constituents.

These methods include the addition of chemicals like nitric acid, sulphuric acid and sodium hydroxide for pH control, refrigeration, or combination of these methods. Detail is given in the following paragraphs (see also Table-3).

7.5 pH Control for Metal Ion Preservation

Concentrated analytical grade nitric acid and sulphuric acid were added to lower the pH to less than 2, to keep metal ions in dissolved state for a maximum of 28 days. Sodium hydroxide was added to the samples in quantities sufficient to raise the pH upto 12 to stabilize the materials for a maximum of 14 days to determine cyanide. Due consideration was given to the dilution effect produced in the volume of the samples.

7.6 Sample Identification

The data was recorded directly in Logbooks and Field Data Record sheets. Sample identifying information such as project code, station location, date, time, samplers, field observations and remarks were also recorded.

7.7 Chain of Custody Procedure

To maintain and document sample possession, chains of custody procedures were followed. To ensure trace-ability of samples while in possession of the laboratory, a method for sample identification was used which is already documented in GEL standard operating procedures (SOPs). Each sample or preparation container was labeled with unique number identifier. This identifier was cross-referenced to the sample Number. Upon receipt of the samples in custody, the sample bottles were inspected along with the information documents by chief chemist of GEL. Chief chemist decided to 'accept' or 'reject' the samples after physical verifications and all appropriate documents. Once the samples were accepted by the laboratory, checked and logged in, the samples were tagged.

7.8 Laboratory Test Methods and Procedures

Best analytical techniques were used for the analysis of target parameters with the available facilities in the laboratory.

A separate sample was collected at each location for the analysis of metals. The entire sample was acidified with concentrated nitric acid to a pH less than two. Volume of 500 ml was transferred in a beaker and digested by adding concentrated HNO_3 and evaporated to near dryness on a hot plate. It was cooled and small amount of HNO_3 was added, covered and refluxed on hot plate. Cooled again and pH was adjusted to 4 by adding 5N NaOH drop wise.

Transferred the digested sample to volumetric flask and made-up the desired volume. All the reagents and chemicals used during the analysis were of analytical grade. The purity of de-ionized, distilled water used for the preparation of calibration standards, reagents and as dilution water was equivalent to ASTM Type II reagent water of Specification D 1193. Blank Values were found to be less than method detection limits (MDL).The standard analytical methods used for analyses are listed in Table-4.

Table-4 Analytical Methods for Water Analysis

S.No.	Parameters	Methods
1	Temperature.	Thermometer
2	pH value.	pH Meter
3	Colour	Spectrophotometer
4	Odour	Dilution
5	Turbidity	Turbidity Meter
6	Electrical Conductivity	Conductivity Meter
7	TDS	Evaporation
8	TSS	Filtration
9	Hardness Ca	Digital Titrator
10	Hardness Mg	Digital Titrator
11	Magnesium	Digital Titrator
12	Chloride	Digital Titrator
13	Sulphate	Spectrophotometer
14	Nitrates	Spectrophotometer
15	Fluoride	Spectrophotometer
16	Sodium Absorption Ratio	Standard Method
17	Residual Sodium Carbonate	Standard Method

18	Ammonia	Spectrophotometer
19	Chromium Total	Spectrophotometer
20	Copper	Spectrophotometer
21	Lead	Spectrophotometer
22	Mercury	Atomic Absorption
23	Selenium	Atomic Absorption
24	Nickel	Spectrophotometer
25	Silver	Atomic Absorption
26	Zinc	Spectrophotometer
27	Iron	Spectrophotometer
28	Barium	Spectrophotometer
M	Manganese	Spectrophotometer
30	Chlorine	Spectrophotometer
31	Boron	Spectrophotometer
32	Cadmium	Merck Method 1.14834
33	Arsenic	Merck Method 1.17927
34	COD	Spectrophotometer
35	BOD	Hach BOD Trak
36	Cyanide	Spectrophotometer
37	Total Colony Count	Culture
38	Total Coliforms	Culture
39	Faecal Coliforms	Culture
40	Faecal Enterococci	Culture

Table-5 Ambient Air Quality & Noise Level Monitoring Methods

S.No.	Parameters	Methods
1	Carbon Monoxide	TESTO CO Monitor
2	Nitrogen dioxide	ISO 6767
3	Sulphur dioxide	ISO 6768
4	PM_{10}	Respirable Dust Sampler for PM_{10}
5	Noise	TES Sound Level Meter
6	Temperature & Humidity	Digital Hygro thermometer

7.9 QA/QC Procedures

Quality assurance programs for analytical measurements is to reduce errors to tolerable limits and provide a means of ensuring that the measurements generated have a high probability of being of acceptable quality. Global Environmental Lab believes in an effective quality assurance system, which provides confidence that a study report meet the pre-established quality standards of accuracy, integrity, completeness and clarity. The precision and accuracy of the procedures used in these analyses were checked by analyzing the Reference stock standard solution.

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8. Results

Table 6: Results of Water Samples

.S.No.	Parameters	Units	NEQS	SW-1	SW-2	SW-3	GW-4
1	Temperature	°C	40	11.0	10.0	12.0	23.0
2	pH value	….	6 - 9	7.4	7.3	7.4	7.5
3	Colour	cu	…..	37	27	43	0
4	Odour	TON	…..	0	0	0	0
5	Turbidity	NTU	…..	42.3	77.1	68.0	6.03
6	Electric Conductivity (EC)	uS/cm	…..	520.0	530.0	550.0	510.0
7	TDS	mg/l	3500.0	322.0	328.0	336.0	314.0
8	TSS	mg/l	200.0	48.0	81.0	78.0	4.0
9	Hardness Ca	mg/l	…..	82.8	78.8	84.0	114.4
10	Hardness Mg	mg/l	…..	40.8	35.6	36.8	44.1
11	Magnesium	mg/l	…..	9.8	8.7	9.0	10.7
12	Chloride	mg/l	1000.0	41.6	42.4	43.5	46.0
13	Sulphate	mg/l	600.0	25.0	24.0	30.0	20.0
14	Nitrates	mg/l	…..	1.0	1.6	1.4	1.7
15	Fluoride	mg/l	10.0	0.28	0.11	0.03	0.21
16	Sodium Absorption Ratio	…..	…..	1.99	1.53	2.10	0.63
17	Residual Sodium Carbonate	mg/l	…..	61.11	57.78	59.41	75.47
18	Ammonia	mg/l	40.0	0.46	0.49	0.48	0.51
19	Chromium Total	mg/l	1.0	0.01	0.01	0.01	0.05
20	Copper	mg/l	1.0	0.02	0.04	0.01	0.02
21	Lead	mg/l	1.0	0.44	0.11	0.21	0.17
22	Mercury	mg/l	0.01	BDL	BDL	BDL	BDL
23	Selenium	mg/l	0.5	BDL	BDL	BDL	BDL
24	Nickle	mg/l	1.0	0.01	0.01	0.02	BDL
25	Silver	mg/l	1.0	BDL	BDL	0.019	BDL
26	Zinc	mg/l	5.0	0.07	0.09	0.07	0.05
27	Iron	mg/l	8.0	0.02	0.03	0.05	0.04
28	Barium	mg/l	1.5	BDL	BDL	BDL	BDL
29	Manganese	mg/l	1.0	0.122	0.104	0.99	0.145
30	Chlorine	mg/l	1.0	0.03	0.07	0.02	0.04
31	Boron	mg/l	6.0	0.5	0.9	1.1	0.6
32	Cadmium	mg/l	0.1	BDL	0.028	0.47	0.064
33	Arsenic	mg/l	1.0	BDL	BDL	BDL	BDL
34	COD	mg/l	150	10	9	15	1
35	BOD_5	mg/l	80	2	2	4	0
36	Cyanide	mg/l	1.0	0.003	0.004	0.003	0.001
37	Total Colony Count	cfu/ml	…..	399	1125	684	80
38	Total Colifroms	cfu/100ml	…..	25	15	20	20
39	Faecal E. Coli	cfu/100ml	…..	Isolated	Nil	Isolated	Nil
40	Faecal Enterococci	cfu/100ml	…..	Nil	Nil	Nil	Nil

SW-1 =Chenab River, SW-2= Sutlej River, SW-3=Barrage, GW-4= Tube Well Irrigation Dept. Colony

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Table 7. Ambient Air Quality Monitoring Results

Location		Panjnad Barrage at Alipur Road (Western Side)			
Sr. No.	Time (Hour)	CO ppm	SO_2 ug/m^3	NO_2 ug/m^3	PM_{10} ug/m^3
1	11:00	1	6.1	7.3	130.5
2	12:00	2	7.2	8.5	128.7
3	13:00	1	5.9	7.6	131.2
4	14:00	1	6.3	7.9	136.5
5	15:00	1	8.1	10.3	130.4
6	16:00	2	6.6	8.1	137.1
7	17:00	1	5.4	7.8	125.4
8	18:00	0	4.8	6.7	118.6
9	19:00	1	4.2	6.2	106.4
10	20:00	0	3.1	4.6	95.2
11	21:00	0	BDL	4.1	101.4
12	22:00	0	BDL	BDL	91.3
13	23:00	0	3.1	5.0	88.4
14	0:00	0	BDL	BDL	81.5
15	1:00	0	2.9	4.2	72.3
16	2:00	0	BDL	BDL	75.4
17	3:00	0	BDL	BDL	70.5
18	4:00	0	BDL	BDL	61.3
19	5:00	0	BDL	BDL	65.2
20	6:00	0	BDL	4.1	82.7
21	7:00	0	4.1	6.2	98.4
22	8:00	1	5.6	7.3	112.6
23	9:00	2	5.2	7.0	121.4
24	10:00	1	6.9	8.5	132.8

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Table 8. Temperature, Humidity & Noise Level Monitoring Report

Location		Panjnad Barrage at Alipur Road (Western Side)		
Sr. No.	Time (Hour)	Temperature °C	Humidity %	Noise Level dB(A)
1	11:00	10.5	48	84.5
2	12:00	11.3	43	78.9
3	13:00	12.2	39	80.4
4	14:00	12.8	34	76.7
5	15:00	13.1	37	78.5
6	16:00	12.9	38	81.2
7	17:00	11.2	43	79.4
8	18:00	8.4	67	80.8
9	19:00	8.4	68	78.2
10	20:00	8.3	69	80.5
11	21:00	8.1	70	74.4
12	22:00	7.5	73	77.1
13	23:00	6.6	75	78.4
14	0:00	6.0	78	75.3
15	1:00	5.4	81	72.4
16	2:00	5.1	81	70.8
17	3:00	4.7	82	69.4
18	4:00	4.1	85	70.5
19	5:00	4.3	86	73.0
20	6:00	5.4	79	78.6
21	7:00	7.1	77	82.2
22	8:00	8.2	60	81.4
23	9:00	8.9	55	83.1
24	10:00	9.4	53	82.9

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Table 9. Temperature, Humidity & Noise Level Monitoring Report

Location		Panjnad Barrage at Alipur Road (Eastern Side)		
Sr. No.	Time (Hour)	Temperature °C	Humidity %	Noise Level dB(A)
1	8:00	7.9	64	83.7
2	9:00	9.6	56	85.6
3	10:00	10.4	42	83.2
4	11:00	14.1	30	80.5
5	12:00	13.4	35	81.1
6	13:00	15.6	32	79.2
7	14:00	14.8	36	82.6
8	15:00	12.5	41	86.3
9	16:00	10.9	47	82.7
10	17:00	9.3	52	80.4
11	18:00	8.9	61	79.6
12	19:00	8.6	65	78.4
13	20:00	7.8	70	77.3
14	21:00	7.5	73	78.5
15	22:00	6.4	76	75.4
16	23:00	5.8	79	74.7
17	0:00	5.1	82	77.2
18	1:00	4.2	86	74.0
19	2:00	3.8	89	75.1
20	3:00	3.1	91	72.5
21	4:00	2.9	92	75.6
22	5:00	3.4	90	76.7
23	6:00	5.2	84	80.5
24	7:00	6.9	70	83.7

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ANNEX-A:

CHENAB RIVER WATER SAMPLING

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ANNEX-B:

SUTLEJ RIVER WATER SAMPLING

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ANNEX-C:
BARRAGE WATER SAMPLING

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ANNEX-D:

GROUND WATER SAMPLING

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ANNEX-E:
AMBIENT AIR QUALITY & NOISE LEVEL MONITORING
(WESTERN SIDE OF BARRAGE)

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ANNEX-F:

NOISE LEVEL MONITORING

(EASTERN SIDE OF BARRAGE)

APPENDIX-4.3

WATER QUALITY GUIDELINES AND STANDARDS

National Standards for Drinking Water Quality

Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Bacterial			
All water intended for drinking (e.Coli or Thermotolerant Coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water entering the distribution system (E.Coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample	Must not be detectable in any 100 ml sample	Most Asian countries also follow WHO standards
Treated water in the distribution system (E. coli or thermo tolerant coliform and total coliform bacteria)	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12-month period.	Must not be detectable in any 100 ml sample In case of large supplies, where sufficient samples are examined, must not be present in 95% of the samples taken throughout any 12 month period.	Most Asian countries also follow WHO standards
Physical			
Colour	≤ 15 TCU	≤ 15 TCU	
Taste	Non objectionable/Acceptable	Non objectionable/Acceptable	
Odour	Non objectionable/Acceptable	Non objectionable/Acceptable	
Turbidity	< 5 NTU	< 5 NTU	
Total hardness as $CaCO_3$	< 500 mg/l	---	
TDS	< 1000	< 1000	
pH	6.5 – 8.5	6.5 – 8.5	
Chemical			
Essential Inorganic	***mg/Litre***	***mg/Litre***	
Aluminium (Al) mg/l	≤ 0.2	0.2	

Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Antimony (Sb)	≤ 0.005 (P)	0.02	
Arsenic (As)	≤ 0.05 (P)	0.01	Standard for Pakistan similar to most Asian developing countries
Barium (Ba)	0.7	0.7	
Boron (B)	0.3	0.3	
Cadmium (Cd)	0.01	0.003	Standard for Pakistan similar to most Asian developing countries
Chloride (Cl)	< 250	250	
Chromium (Cr)	≤ 0.05	0.05	
Copper (Cu)	2	2	
Toxic Inorganic	***mg/Litre***	***mg/Litre***	
Cyanide (CN)	≤ 0.05	0.07	Standard for Pakistan similar to Asian developing countries
Fluoride (F)*	≤ 1.5	1.5	
Lead (Pb)	≤ 0.05	0.01	Standard for Pakistan similar to most Asian developing countries
Manganese (Mn)	≤ 0.5	0.5	
Mercury (Hg)	≤ 0.001	0.001	
Nickel (Ni)	≤ 0.02	0.02	
Nitrate (NO_3)*	≤ 50	50	
Nitrite (NO_2)*	≤ 3 (P)	3	
Selenium (Se)	0.01(P)	0.01	
Residual chlorine	0.2-0.5 at consumer-end 0.5-1.5 at source	—	
Zinc (Zn)	5.0	3	Standard for Pakistan similar to most Asian developing countries

* indicates priority health related inorganic constituents which need regular monitoring.

Properties/Parameters	Standard Values for Pakistan	Who Standards	Remarks
Organic			
Pesticides mg/L		PSQCA No. 4639-2004, Page No. 4 Table No. 3 Serial No. 20- 58 may be consulted.***	Annex II
Phenolic compounds (as Phenols) mg/L		≤ 0.002	
Polynuclear aromatic hydrocarbons (as PAH) g/L		0.01 (By GC/MS method)	
Radioactive			
Alpha Emitters bq/L or pCi	0.1	0.1	
Beta emitters	1	1	

*** PSQCA: Pakistan Standards Quality Control Authority.

GUIDELINES FOR INTERPRETATIONS OF WATER QUALITY FOR IRRIGATION[1]

Potential Irrigation Problem				Units	Degree of Restriction on Use		
					None	Slight to Moderate	Severe
Salinity *(affects crop water availability)*[2]							
	EC_w			dS/m	< 0.7	0.7 – 3.0	> 3.0
	(or)						
	TDS			mg/l	< 450	450 – 2000	> 2000
Infiltration *(affects infiltration rate of water into the soil. Evaluate using EC_w and SAR together)*[3]							
SAR	= 0 – 3	**and EC_w**	=		> 0.7	0.7 – 0.2	< 0.2
	= 3 – 6		=		> 1.2	1.2 – 0.3	< 0.3
	= 6 – 12		=		> 1.9	1.9 – 0.5	< 0.5
	= 12 – 20		=		> 2.9	2.9 – 1.3	< 1.3
	= 20 – 40		=		> 5.0	5.0 – 2.9	< 2.9
Specific Ion Toxicity *(affects sensitive crops)*							
	Sodium (Na)[4]						
	surface irrigation			SAR	< 3	3 – 9	> 9
	sprinkler irrigation			me/l	< 3	> 3	
	Chloride (Cl)[4]						
	surface irrigation			me/l	< 4	4 – 10	> 10
	sprinkler irrigation			me/l	< 3	> 3	
	Boron (B)[5]			mg/l	< 0.7	0.7 – 3.0	> 3.0
	Trace Elements (see Table 21)						
Miscellaneous Effects *(affects susceptible crops)*							
	Nitrogen (NO_3 - N)[6]			mg/l	< 5	5 – 30	> 30
	Bicarbonate (HCO_3)						
	(overhead sprinkling only)			me/l	< 1.5	1.5 – 8.5	> 8.5
	pH				**Normal Range 6.5 – 8.4**		

[1] Adapted from University of California Committee of Consultants 1974.

[2] ECw means electrical conductivity, a measure of the water salinity, reported in deciSiemens per metre at 25°C (dS/m) or in units millimhos per centimetre (mmho/cm). Both are equiva-lent. TDS means total dissolved solids, reported in milligrams per litre (mg/l).

[3] SAR means sodium adsorption ratio. SAR is sometimes reported by the symbol RNa. See Figure1 for the SAR calculation procedure. At a given SAR, infiltration rate increases as watersalinity increases. Evaluate the potential infiltration problem by SAR as modified by ECw.Adapted from Rhoades 1977, and Oster and Schroer 1979.

[4] For surface irrigation, most tree crops and woody plants are sensitive to sodium and chlor-ide; use the values shown. Most annual crops are not sensitive; use the salinity tolerance tables (Tables 4 and 5). For chloride tolerance of selected fruit crops, see Table 14. With overhead sprinkler irrigation and low

humidity (< 30 percent), sodium and chloride may be absorbed through the leaves of sensitive crops. For crop sensitivity to absorption, see Tables 18, 19 and 20.

[5] For boron tolerances, see Tables 16 and 17.

[6] NO_3 -N means nitrate nitrogen reported in terms of elemental nitrogen (NH_4 -N and Organic-N should be included when wastewater is being tested).

Source: Water Quality for Agriculture: FAO Irrigation and Drainage Paper 29 by R.S. Ayers and D.W. Westcot 1985

The 1986 criteria statement for bacteriological criteria follows:

EPA Criteria for Bathing (Full Body Contact)
Recreational Waters

Freshwater

Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following:[1]

E. coli	126 per 100 ml; or
Enterococci	33 per 100 ml.

No sample should exceed a one sided confidence limit (C.L.) calculated using the following as guidance:

Designated bathing beach 75% C.L.
Moderate use for bathing 82% C.L.
Light use for bathing 90% C.L.
Infrequent use for bathing 95% C.L.

based on a site-specific log standard deviation, or if site data are insufficient to establish a log standard deviation, then using 0.4 as the log standard deviation for both indicators.

Marine Water

Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the enterococci densities should not exceed 35 per 100 ml.

No sample should exceed a one sided confidence limit using the following as guidance:

Designated bathing beach 75% C.L.
Moderate use for bathing 82% C.L.
Light use for bathing 90% C.L.
Infrequent use for bathing 95% C.L.

based on a site-specific log standard deviation, or if site data are insufficient to establish a log standard deviation, then using 0.7 as the log standard deviation.

[1]Only one indicator should be used. The regulatory agency should select the appropriate indicator for its conditions.

WATER QUALITY PARAMETERS (WAPDA STANDARDS)

Symbols	Usable	Marginal	Hazardous
EC x 10^6	0 - 1500	1500 - 3000	> 3000
RSC (meq/l)	0 – 2.5	2.5 – 5.0	> 5.0
SAR	0 – 10	10 – 18	> 18

CSR

C = EC x 10^6 (Conductivity)

S= SAR (Sodicity)

R = RSC (Sodicity)

APPENDIX-6.1

RAPID ENVIRONMENTAL ASSESSMENT (REA)

ADB's Environment Policy

Rapid Environmental Assessment (REA) Checklist

IRRIGATION

Country/Project Title: Pakistan / Panjnad Barrage Rehabilitation and Upgrading

Prepared by: Water Resources Division NESPAK (Project Consultant)

SCREENING QUESTIONS	YES	No	REMARKS
A. Project Siting Is the Project area adjacent to or within any of the following environmentally sensitive areas?			
• Protected Area		✓	
• Wetland	Barrage pond area may considered as wetland but it is not a classified wetland		No impact on wetland is anticipated from the project.
• Mangrove		✓	
• Estuarine		✓	
• Buffer zone of protected area		✓	
• Special area for protecting biodiversity		✓	
No permanent adverse environmental impact is anticipated from the project siting. All the impacts will be of temporary nature and mitigable.			
B. Potential Environmental Impacts Will the Project cause...			

SCREENING QUESTIONS	YES	No	REMARKS
• Loss of precious ecological values (e.g. result of encroachment into forests/swamp lands or historical/cultural buildings/areas, disruption of hydrology of natural waterways, regional flooding, and drainage hazards)?		✓	
• Conflicts in water supply rights and related social conflicts?		✓	No conflicts in water supply rights are anticipated as there will be no change in water courses.
• Impediments to movements of people and animals?	✓		Temporary impediments during construction will be minimized through careful selection of Labour camp locations and provision of alternative routes and access paths. if closed or used by the contractor.
• Potential ecological problems due to increased soil erosion and siltation, leading to decreased stream capacity?		✓	
• Insufficient drainage leading to salinity intrusion?		✓	
• Over pumping of groundwater, leading to salinization and ground subsidence?		✓	Over pumping of groundwater is not anticipated. Groundwater pumping for the water supply to the labour camp and batching plant is negligible compared to the available ample source of groundwater. The aquifer would be recovered/recharged easily and will not be affected adversely
• Impairment of downstream water quality and therefore, impairment of downstream beneficial uses of water?		✓	
• Dislocation or involuntary resettlement of people?			A Resettlement Action Plan will be prepared and applied before start of construction of the project
• Potential social conflicts arising from land tenure and land use issues?		✓	
• Soil erosion before compaction and lining of canals?		✓	Canal lining is not included in the scope of work
• Noise from construction equipment?		✓	It will be further ensured that suitable plant & equipment are used on site. Regular noise monitoring during construction phase will minimize noise. The construction area is away from the populated areas.

SCREENING QUESTIONS	YES	No	REMARKS
• dust?	✓		Mitigation through sprinkling water when required. 24 hours monitoring of dust is proposed in Environment Monitoring Plan
• Labour-related social problems especially if workers from different areas are hired?		✓	Sufficient local source of labour is available. Outside labour will be employed only for those skills for which local skilled labour is not available. Regular awareness courses will be arranged on communicable diseases/HIV AIDS during construction for project labour.
• Waterlogging and soil salinization due to inadequate drainage and farm management?		✓	No water logging and salinization impact is anticipated from the project implementation
• Leaching of soil nutrients and changes in soil characteristics due to excessive application of irrigation water?		✓	
• Reduction of downstream water supply during peak seasons?		✓	Work will be managed during routine canal closure and design provides cofferdams & temporary structures at necessary points.
• Soil pollution, polluted farm runoff and groundwater, and public health risks due to excessive application of fertilizers and pesticides?		✓	
• Soil erosion (furrow, surface)?		✓	
• Scouring of canals?		✓	
• Logging of canals by sediments?		✓	
• Clogging of canals by weeds?		✓	
• Seawater intrusion into downstream freshwater systems?		✓	
• Introduction of increase in incidence of waterborne or water related diseases?		✓	No change in quality of water is anticipated from the project activities

APPENDIX-7.1

CHECKLISTS

Checklists for Camp Site

Description	***Status***	***Notes***
Is the camp layout according to the design documents?	Yes ☐ No ☐	
Has the campsite been selected in consultation with the consultants' environmental team?	Yes ☐ No ☐	
Have the photographs been taken to record the pre camping conditions?	Yes ☐ No ☐	
Are there any settlements within 500 meters of the campsite?	Yes ☐ No ☐	
Has the camp been established in the existing clearings / designated area?	Yes ☐ No ☐	
Was the hunting, fishing, or capturing wildlife, or discharging fireman avoided?	Yes ☐ No ☐	
Was the harassment or pushing of wildlife avoided?	Yes ☐ No ☐	
Has any vegetation been cleared? If yes, is the vegetation loss significant? If yes, have mitigation measures been discussed and agreed?	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐	
Has any trees felled?	Yes ☐	

	No ☐	
Have the trees or bushes been burnt?	Yes ☐ No ☐	
Have bushes been disposed off in a water body or dry streambed?	Yes ☐ No ☐	
Has the natural drainage been disturbed or blocked?	Yes ☐ No ☐	
Has the septic tank been built for sewerage? Has the soaking pits or sump been built for wastewater disposal?	Yes ☐ No ☐ Yes ☐ No ☐	
Has the sump been built in absorbent soil?	Yes ☐ No ☐	
Has the sump been built down-slope from the camp?	Yes ☐ No ☐	
Is the sump covered, in order to reduce access of insects and animals?	Yes ☐ No ☐	
Do the fuel storage facilities have adequate secondary containments arrangements in case of leakage or spilling?	Yes ☐ No ☐	
Is the concrete pad has been constructed for fuel, oils and other chemical liquid transfer?	Yes ☐ No ☐	
Is the updated fire fighting equipment available near fuel storage area?	Yes ☐ No ☐	
Is the fuel storage downwind and down slope of the	Yes ☐	

camp?	No ☐	
Is there any other combustible or flammable material in the fuel storage area?	Yes ☐ No ☐	
Are the fuel tanks properly marked with their contents and precautions?	Yes ☐ No ☐	

Note:

Signature Date

ESU

Consultants' Environmentalist

Contractor's Environmentalist

Checklists for Borrow Areas

Description	*Status*	*Notes*
Is the borrow area is marked according to the design documents?	Yes ☐ No ☐	
Has the borrow area been selected in consultation with the consultants' environmental team?	Yes ☐ No ☐	
Have the photographs been taken to record the pre camping conditions?	Yes ☐ No ☐	
Has the access roads been established in the existing clearings / designated area?	Yes ☐ No ☐	
Has any vegetation been cleared? If yes, is the vegetation loss significant? If yes, have mitigation measures been discussed and agreed?	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐	
Has any trees felled?	Yes ☐ No ☐	
Have the trees or bushes been burnt?	Yes ☐ No ☐	
Has the natural drainage been disturbed or blocked?	Yes ☐ No ☐	
Has the borrow area been fenced to avoid animal access and human safety?	Yes ☐ No ☐	

Is there proper mechanism to control dust pollution?	Yes ☐ No ☐	
Does the borrowed earth used for filling meet the specifications?	Yes ☐ No ☐	

Note:

Signature Date

ESU

Consultants' Environmentalist

Contractor's Environmentalist

Checklists for Access Roads

Description	*Status*	*Notes*
Has the access roads selected in consultation with the consultants' environmental team	Yes ☐ No ☐	
Have the photographs been taken to record the pre-construction conditions?	Yes ☐ No ☐	
Are there any settlements within 500 meters of the construction	Yes ☐ No ☐	
Has the access roads been established in the existing clearings or designated site	Yes ☐ No ☐	
Was the harassment or pushing of wildlife avoided in establishment of access roads	Yes ☐ No ☐	
Has any vegetation been cleared? If yes, is the vegetation loss significant? If yes, have mitigation measures been discussed and agreed?	Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No ☐	
Has any trees felled?	Yes ☐ No ☐	
Has the compacted gravel topping provided access roads?	Yes ☐ No ☐	

Has the excavated earth / silt disposed off properly?	Yes ☐ No ☐	
Do the access roads have sufficient width?	Yes ☐ No ☐	
Do the diversion signs and required signs boards placed on the access roads?	Yes ☐ No ☐	

Note:

Signature Date

ESU

Consultants' Environmentalist

Contractor's Environmentalist

Checklists for Construction Work Site

Description	*Status*	*Notes*
Is the construction site layout is according to the design documents?	Yes ☐ No ☐	
Has the construction site selected in consultation with the consultants' environmental team?	Yes ☐ No ☐	
Have the photographs been taken to record the pre-construction conditions?	Yes ☐ No ☐	
Are there any settlements within 500 meters of the construction?	Yes ☐ No ☐	
Has the construction site been established in the existing clearings or designated site	Yes ☐ No ☐	
Does the temporary diversion channel built per specifications?	Yes ☐ No ☐	
Was the hunting, fishing, or capturing wildlife, or discharging fireman avoided?	Yes ☐ No ☐	
Was the harassment or pushing of wildlife avoided?	Yes ☐ No ☐	
Was the disposal of waste material in the protected area avoided?	Yes ☐ No ☐	
Has any vegetation been cleared?	Yes ☐ No ☐	

If yes, is the vegetation loss significant? If yes, have mitigation measures been discussed and agreed?	Yes ☐ No ☐ Yes ☐ No ☐	
Has any trees felled?	Yes ☐ No ☐	
Has the excavated earth / silt disposed off properly?	Yes ☐ No ☐	
Does the borrowed earth used for filling meet the specifications?	Yes ☐ No ☐	
Has the natural drainage been disturbed or blocked?	Yes ☐ No ☐	
Has the septic tank been built for wastewater disposal?	Yes ☐ No ☐	
Is the soaking pits or sump covered, in order to reduce access of insects and animals?	Yes ☐ No ☐	
Do the fuel storage facilities have adequate secondary containments arrangements in case of leakage or spilling?	Yes ☐ No ☐	
Is the concrete pad has be constructed for fuel, oils and other chemical liquid transfer	Yes ☐ No ☐	
Is the fire fighting equipment available near fuel storage area?	Yes ☐ No ☐	
Is the fuel storage downwind and down slope of the camp?	Yes ☐ No ☐	

Is there any other combustible or flammable material in the fuel storage area?	Yes ☐ No ☐	
Are the fuel tanks properly marked with their contents?	Yes ☐ No ☐	

Note:

Signature Date

ESU

Consultants' Environmentalist

Contractor's Environmentalist

APPENDIX-7.2

ENVIRONMENTAL ISSUES TRACKING REPORT

Environmental Issues Tracking Report

Tracking No.	Log Date	Source	Location	Issue	Action Required	Responsibility	Target date	Completion Status

APPENDIX-7.3

LIST OF TREES

List of Trees

Sr. #	Location		Name of Species		Trees at site		Status	Economic Utilization			Condition	Remarks
	Upstream of Barrage	Downstream of Barrage	Common Name	Scientific Name	Young (Girth < 24")	Mature (Girth > 24")	(P or G)	Timber	Fuel wood	Fruit tree		
1	✔		Sheesham	*Dalbergia Sisso*		✔	G	✔			Good	Suitable for High Quality furniture
2	✔		Sheesham	*Dalbergia Sisso*		✔	G	✔			Good	Suitable for High Quality furniture
3	✔		Sheesham	*Dalbergia Sisso*		✔	G	✔			Good	Suitable for High Quality furniture
4	✔		Sheesham	*Dalbergia Sisso*		✔	G	✔			Good	Suitable for High Quality furniture
5	✔		Sheesham	*Dalbergia Sisso*		✔	G	✔			Good	Suitable for High Quality furniture
6	✔		Sheesham	*Dalbergia Sisso*		✔	G	✔			Good	Suitable for High Quality furniture
7	✔		Sheesham	*Dalbergia Sisso*		✔	G	✔			Good	Suitable for High Quality furniture
8	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
9	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
10	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
11	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
12	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
13	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
14	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
15	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
16	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning

Sr. #	Location		Name of Species		Trees at site		Status	Economic Utilization			Condition	Remarks
	Upstream of Barrage	Downstream of Barrage	Common Name	Scientific Name	Young (Girth < 24")	Mature (Girth > 24")	(P or G)	Timber	Fuel wood	Fruit tree		
17	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
18	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
19	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
20	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
21	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
22	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
23	✔		Safeda	*Eucalyptus*		✔	G		✔		Good	Suitable for
24	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
25	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
26	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
27	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
28	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
29	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
30	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
31	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
32	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
33	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
34	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
35	✔		Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning

Sr. #	Location		Name of Species		Trees at site		Status	Economic Utilization			Condition	Remarks
	Upstream of Barrage	Downstream of Barrage	Common Name	Scientific Name	Young (Girth < 24")	Mature (Girth > 24")	(P or G)	Timber	Fuel wood	Fruit tree		
36	✔		Manger	*Thuja plicata*		✔	G	✔			Good	Suitable for quality furniture
37	✔		Beri	*Zizyphus jujube*		✔	G			✔	Good	Used as Fruit
38	✔		Bakain	*Melia azedarach*		✔	G	✔			Good	Suitable for quality furniture
39		✔	Sheesham	*Dalbergia Sisso*		✔	G	✔			Good	Suitable for High Quality furniture
40		✔	Sheesham	*Dalbergia Sisso*		✔	G	✔			Good	Suitable for High Quality furniture
41		✔	Kikar	*Acacia nilotica*		✔	G	✔			Good	Used in Ordinary furniture
42		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
43		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
44		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
45		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
46		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
47		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
48		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
49		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
50		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
51		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
52		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
53		✔	Safeda	*Eucalyptus camaldulensis*		✔	G		✔		Good	Suitable for burning
54		✔	Jamun	*Syzygium cumini*		✔	G			✔	Good	Fruit
55		✔	Bakain	*Melia azedarach*		✔	G	✔			Good	Suitable for quality furniture